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2024 Water System Facility Plan

Report

City of

North Liberty, IA

April 2025

STRAND ASSOCIATES®

Report for

City of North Liberty, Iowa

2024 Water System Facility Plan

Prepared by:

STRAND ASSOCIATES, INC.®
414 South 17th Street, Suite 107
Ames, IA 50010
www.strand.com

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CERTIFICATION PAGE

CITY OF NORTH LIBERTY, IOWA
2024 WATER SYSTEM FACILITY PLAN

LICENSED PROFESSIONAL ENGINEER JENNIFER S. RUDDY P22830 IOWA	I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. Jennifer Ruddy 4/3/2025 JENNIFER S. RUDDY, P.E. DATE License number P22830 My license renewal date is December 31, 2026. Pages or sheets covered by this seal: All.

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EXECUTIVE SUMMARY

BACKGROUND

The City of North Liberty, Iowa (City) is responsible for potable water service to residences, businesses, and institutions within the City. The City sources its water from the Jordan and Silurian aquifers, and is treated and distributed to the City's customers. Increased water demand in the City is primarily due to the City's growing population. As population grows, water treatment, raw water supply, and water storage capacities will need to grow to meet increasing water demands. Additionally, water main improvements are required to provide adequate service in the distribution system.

DESIGN CONDITIONS

The City's population as of 2023 was estimated to be 22,710. The population is expected to grow to approximately 34,310 by 2035 and 48,400 by 2045, based on a 3.5 percent annual growth rate. Population growth will drive the need for improvements to water treatment, water supply, water storage, and water mains in the distribution system.

Average day demands (ADD) and peak day demands (PDD) in 2023 were approximately 1.29 and 1.97 million gallons per day (MGD), respectively. This translates to 57 gallons per capita per day (gpcd) average use, and 87 gpcd peak day use. Over the past 6 years, average daily per capita use was 61 gpcd and peak day use was 111 gpcd. To provide adequate conservatism to water demand projections, average day use was estimated at 70 gpcd and peak day use was estimated at 120 gpcd in this report. At the design year of 2045, ADDs are projected to be approximately 3.39 MGD and PDDs are projected to be approximately 5.81 MGD. Improvements to water treatment, water supply, and water storage capacities will be required to meet projected 2045 water demands.

EXISTING FACILITIES

The City owns and operates a water system consisting of six active local groundwater supply wells drawing from the Jordan and Silurian aquifers, a nanofiltration (NF) membrane water treatment plant (WTP), 2.15 million gallons (MG) of finished water storage capacity, an aquifer storage and recovery (ASR) well, and a water distribution and transmission system that spans the City limits.

Raw water supply is provided by three Silurian wells (Well Nos. 3, 4, and 9) and three Jordan wells (Well Nos. 5, 6, and 8) for a total capacity of 3,400 gallons per minute (gpm) (2,300 gpm firm capacity). Well Nos. 3 and 4 have significantly lower capacity, are approximately 40 years old, and may be taken out of service or abandoned during the 20-year planning period. With Well Nos. 3 and 4 out of service, the total raw water capacity is 3,320 gpm (2,220 gpm firm capacity).

The City has operated its NF WTP located at 433 South Front Street since it finished construction in 2018. The plant was constructed for an intended design production capacity of 3.0 MGD and a design intent to provide adequate capacity for a population of approximately 28,940, as noted in the previous *2016 Facility Plan Amendment No. 1*. Actual current water treatment capacity based on normal operation (20 hours of operation, 20.5 percent bypass to achieve 100 milligrams per liter maximum hardness) is 3.17 MGD. Firm capacity (one supply well and one NF skid out of service) is 2.96 MGD.

The City's ASR well (Well No. 7) can provide up to 1.32 MGD of finished water. In recent years, use of the ASR well has not be necessary to meet peak demands and, therefore, it has not been used since 2019. The City wants to consider discontinuing use of the ASR well and converting this well into a raw water source.

Distribution storage is provided by two water towers (with volumes of 0.4 and 1.0 MG, respectively) and one 0.75-MG ground storage reservoir.

WATER SYSTEM EXPANSION ALTERNATIVES

As populations increase, water treatment capacity will need to be increased incrementally. In order to adequately feed the WTP, raw water supply will also need to increase. Phase 1 treatment capacity denotes the existing capacity of the WTP. The existing membrane skids can be expanded to have an additional 10 percent capacity. Additionally, there is space for two more full membrane skids. In Phase 1A, the existing membrane skids will be built out to their full capacities. In Phases 2 and 3, one additional skid will be added per phase.

Additional raw water supply will primarily come from the drilling of additional wells in the Silurian aquifer. Two alternatives were considered for water supply expansion, which can be summarized as:

1. Alternative No. 1–The ASR well remains in service.
2. Alternative No. 2–The ASR well is converted into a raw water supply well.

In Alternative No. 1, the ASR well remains in service as an ASR well, and is able to provide additional peak day finished water capacity. In this case, only Phase 1A and Phase 2 WTP expansions will be required through the design year (2045).

In Alternative No. 2, the ASR well is converted into a raw water supply well, which could provide up to 1,100 gpm of additional raw water capacity, contingent on the appropriate aquifer modeling and permits. In this case, construction of additional Silurian wells could be delayed by approximately 1 year, but WTP expansions will be required sooner. Phase 1A, Phase 2, and Phase 3 WTP expansions will be required through the design year (2045).

Distribution system and storage improvements will be required to provide adequate storage and service through 2045, regardless of which alternative is chosen. Storage volume will need to be increased by 1.25 MG to provide adequate storage through 2045. Additionally, several water main improvements are recommended to increase system looping, mitigate water service disruptions, and provide additional redundancy through 2045.

Table ES-1 presents a summary opinion of probable costs (OPC) for supply, treatment, and storage improvements for Alternative No. 1 in 2024 dollars.

Project Description	Estimated Year Completed	OPC
Phase 1A		
Two New Silurian Wells	2028	$6,610,000
Membrane Replacement and Buildout	2028	$1,270,000
Phase 2		
1.25-MG Water Tower	2031	$8,393,000
Five New Silurian Wells	2037	$11,815,000
Added Membrane Skid and Phase 2 Treatment Improvements	2037	$3,457,000
Total OPC		**$31,545,000**

Table ES-1 Alternative No. 1 Water Supply, Treatment, and Storage OPC Summary

Table ES-2 presents a summary OPC for supply, treatment, and storage improvements for Alternative No. 2 in 2024 dollars.

Project Description	Estimated Year Completed	OPC
Phase 1A		
Well No. 7 Conversion	2028	$1,010,000
Membrane Replacement and Buildout	2028	$1,270,000
Phase 2		
Two New Silurian Wells	2028	$6,610,000
Added Membrane Skid and Phase 2 Treatment Improvements	2028	$3,457,000
1.25-MG Water Tower	2031	$8,393,000
Phase 3		
Five New Silurian Wells	2038	$11,815,000
Add Membrane Skid and Phase 3 Treatment Improvements	2038	$2,325,000
Total OPC		**$34,880,000**

Table ES-2 Alternative No. 2 Water Supply, Treatment, and Storage OPC Summary

The total OPC for improvements through 2045 for Alternative No. 1 is approximately 10 percent less than Alternative No. 2. At the study phase of alternative evaluation, a 10 percent difference is considered approximately equivalent. In addition to the monetary evaluation, a nonmonetary evaluation between alternatives is valuable. Table ES-3 summarizes the results of the comparison of each alternative considering several nonmonetary factors.

Criteria	Description	Alternative No. 1	Alternative No. 2
1	Operational Complexity	0	1
2	Reliability	0	1
3	Operational Flexibility	0	1
4	Expandability	1	1
5	Implementation	1	0
6	Maintenance Requirements	0	1
7	Ability to Meet Future Regulation	0	1
8	Social Impacts	1	0
	Composite Score	**3**	**6**

Table ES-3 Evaluation of Alternatives by Nonmonetary Criteria

Water main improvements are needed on the basis of population growth, and timing is determined by timing and location of development in the City, criticality of the deficiency being addressed, water main age, the City's preference, and other factors. Table ES-4 presents a summary of the OPC for recommended water main improvements through 2045.

Improvement No.	Description	Years Until Completed	Present Worth OPC
1	12-Inch Water Main Loop Between Harlen Street and Forevergreen Road	5 to 10	$262,000
2	8-Inch Water Main Between 230th Street and Pheasant Lane	0 to 5	$137,000
3	12-Inch Water Main Loop on North Liberty Road	0 to 5	$1,034,000
4	8-Inch Water Main Loop Between Dubuque Street and East Tartan Drive	0 to 5	$296,000
5	12-Inch Water Main Loop on Jasper Avenue	5 to 10	$1,559,000

Table ES-4 Water Main Improvement OPC Summary

IMPACT ON USER RATES

As with any capital-intensive water project, the financed portion as well and operational and maintenance expenses will need to be funded through user rates. A detailed evaluation of the potential impact of this project on user rates is beyond the scope of this study. The City should consult with a trusted financial advisor to provide guidance on which type of funding is recommended for the City, the preferred loan term, and the final impact on water user fees.

SUMMARY AND RECOMMENDATIONS

Alternative Nos. 1 and 2 were evaluated based on monetary and nonmonetary criteria. While Alternative No. 1 has a lower OPC, Alternative No. 2 had a higher rating based on the nonmonetary criteria. Alternative No. 2 will help reduce the stress on the Jordan aquifer by distributing pumping over more wells and a larger area. It also improves reliability and flexibility of the raw water supply by having another high capacity well. Given these benefits, Alternative No. 2 is recommended, which includes completing Phases 1A and 2 for supply and treatment by year 2028.

Based on the evaluations presented in this *2024 Water System Facility Plan* (Facility Plan), the following recommendations are offered:

1. Proceed with increasing the raw water supply by completing the following improvements, with an estimated completion in 2028:

    a. Construct two additional Silurian wells and associated raw water main.

    b. Convert the existing ASR to a water supply well.

2. Proceed with increasing the water treatment capacity by completing the following improvements, with an estimated completion in 2028:

    a. Expand the capacity of the existing NF skids by 10 percent by adding membranes and replace the existing membrane elements as needed.

    b. Add a fourth NF skid and other WTP improvements identified in this Facility Plan.

3. Proceed with planning and budgeting for adding a new 1.25-MG water tower, with an estimated completion of 2031.

4. Proceed with planning and budgeting for water main Improvement Nos. 2 through 4 summarized in Table ES-4, to be completed within the next 5 years.

The concepts presented in this Facility Plan should be reviewed and discussed and decisions made regarding the specific features and components to be included in the selected plan. Part of the decision process will include deciding how quickly to expand the facilities to meet the growing needs of the community. The City should concur with the concepts as presented or direct that revised analyses be made. Following acceptance by the City, the Facility Plan should be submitted to the Iowa Department of Natural Resources (IDNR) for review and approval. Following comment by the IDNR, the design phase of the selected project should be initiated, as appropriate.

Once a decision is reached, then discussions can proceed on various preliminary design aspects associated with the selected plan. Some recommendations and analyses discussed in this Facility Plan may merit more detailed examination. During the design development stage, numerous decision points will arise regarding specific features of the proposed project. It can then be decided which recommendations to include in the selected plan and which deviations to make from the concepts proposed by this analysis.

SCHEDULE

The following schedule is proposed for completing the water system improvements as outlined in this Facility Plan, presuming population growth is as projected. The City should continue to monitor population growth and adjust the schedule accordingly.

Project Milestone	Month and Year	OPC
Submit Facility Plan to IDNR	April 2025	
IDNR Facility Plan Review	April to December 2025	
Phases 1A and 2–Water Supply and Treatment		**$12,347,000**
Preliminary Design (concurrent with IDNR review)	August to December 2025	
Final Design	January to September 2026	
IDNR Review and Permitting	September to February 2026	
Bidding	February to March 2027	
Construction	April 2027 to November 2028	
Phase 2–Water Storage		**$8,393,000**
Project Design	July to June 2029	
IDNR Review and Permitting	July to December 2029	
Bidding	January to February 2030	
Construction	March 2030 to October 2031	
Water Main Improvements		**$1,467,000**
Project Design	January to October 2027	
IDNR Review and Permitting	November 2027 to February 2028	
Bidding	February to March 2028	
Construction	April 2028 to October 2029	

Table ES-5 Proposed Project Schedule

SECTION 1
INTRODUCTION

The City of North Liberty, Iowa (City) has authorized preparation of a *Water System Facility Plan* (Facility Plan) to identify specific improvements required for the City's water treatment plant (WTP) and study the performance and potential improvements to the water system, including distribution piping, water storage, and raw water supply. The Facility Plan includes an evaluation of the existing supply, treatment, and storage capacities; scheduling for improvements; and an opinion of probable cost (OPC) for recommended improvements. This report is intended to serve as a master planning document for water system improvements for the next 20 years, up to the year 2045.

This section provides background information regarding the project location, authority, purpose, and scope of study.

1.01 BACKGROUND

The City is responsible for potable water service to residences, businesses, and institutions within the City. The City sources its water from the Jordan and Silurian aquifers, and is treated and distributed to the City's customers. The City has operated its nanofiltration (NF) membrane WTP located at 433 South Front Street since it finished construction in 2018. The WTP was constructed for an intended design production capacity of 3.0 million gallons per day (MGD) and a design intent to provide adequate capacity for a population of approximately 28,940, as noted in the previous *2016 Facility Plan Amendment No. 1*. This population is anticipated to be reached by 2028, after which, planned improvements would be required.

1.02 PURPOSE AND SCOPE OF STUDY

The purpose of this Facility Plan is to review the existing water supply, production, distribution, and storage facilities owned and operated by the City, and determine future needs based on the current condition, expected equipment lifespan, and projected water demands.

This Facility Plan includes the following major task elements:

1. Establish current and projected water demands through 2045 based on water production and WTP operational data from the past 5 years.

2. Update the *2013 Water System Facility Plan* addressing capacity and modifications to the existing municipal water supply, treatment, storage, and distribution system for a 20-year planning period.

3. Evaluate the need for additional raw water supply wells.

4. Evaluate the need and anticipated schedule for expanding the existing WTP for current and projected water demands over the planning period.

5. Evaluate iron removal needs regarding raw water bypassing around the NF system.

6. Evaluate finished water storage based on current and projected water demands.

7. Update the water distribution system model using WaterCAD software.

8. Evaluate for major water main loop sizes and locations to serve potential growth areas.

9. Develop OPCs for recommended improvements.

10. Prepare a final Facility Plan document summarizing recommended options, OPCs, and scheduling for improvements.

11. Meet with City staff and officials to review findings and finalize the Facility Plan.

1.03 ABBREVIATIONS AND DEFINITIONS

AACE	Advancement of Cost Engineering
ADD	average day demand
ASR	aquifer storage and recovery
AWWA	American Water Works Association
City	City of North Liberty, Iowa
DWSRF	Drinking Water State Revolving Fund
EST	elevated storage tank
Facility Plan	*Water System Facility Plan*
fps	feet per second
GIS	geographic information system
GO	General Obligation
gpcd	gallons per capita per day
gpd	gallons per day
gph	gallons per hour
gpm	gallons per minute
Grimes	City of Grimes, Iowa
GST	ground-level storage tank
Hawkins	Hawkins, Inc.
HFPO-DA	Hexafluoropropylene oxide-dimer acid
hp	horsepower
I-	Interstate
IDNR	Iowa Department of Natural Resources
ISO	Insurance Services Office
MCL	maximum contaminant level
MCLG	maximum contaminant level goals
MG	million gallons
mg/L	milligrams per liter
MGD	million gallons per day
mm	millimeter
NA	not applicable
NF	nanofiltration
OPC	opinion of probable cost
pCi/L	picocuries per liter

PDD	peak day demand
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHxS	perfluorohexanesulfonic acid
PFNA	perfluorononanoic acid
PFOA	Perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
ppt	parts per trillion
PRV	pressure reducing valve
psi	pounds per square inch
SDWA	Safe Drinking Water Act
SEP	source entry point
sf	square feet
Strand	Strand Associates, Inc.®
Ten State Standards	Ten State Standards for Water Works
U.S.	United States
UI	University of Iowa
USEPA	United States Environmental Protection Agency
VFD	variable frequency drive
WTP	water treatment plant
WWTP	wastewater treatment plant

SECTION 2
DESIGN CONDITIONS

2.01 PLANNING PERIOD

The planning period of the *2013 Water System Facility Plan* assumed Phases 1 and 2 would provide adequate capacity through 2027 and 2037, respectively, based on facility construction completion in 2017. The *2016 Facility Plan Amendment No. 1* revised the Phase 1 and 2 design years to 2028 and 2038, based on construction completion in 2018.

This Facility Plan will reevaluate and update the Phase 2 and 3 expansion timelines according to present-day projections and operational data. The goal of this report is to address future raw water and treatment capacity, potential changes in treatment needs, storage capacity, and distribution system improvements for a 20-year planning period.

2.02 POPULATION PROJECTIONS

Water demand for domestic and commercial use is very closely related to the population served. The City is largely residential with minimal industrial water uses and, therefore, population growth is the primary factor in projecting future water demands. Historical population data for the City was obtained from the United States (U.S.) Census Bureau for 1970 through 2020, as presented in Table 2.02-1.

Year	Population
1970	1,055
1980	2,046
1990	2,926
2000	5,367
2010	13,374
2020	20,479

Table 2.02-1 Historical Population Data

Figure 2.02-1 presents historical population growth based on U.S. Census Bureau data for 2000 through 2020, future population growth based on projections from the *2013 Water System Facility Plan*, as well as current population growth projections based on a 3.5 percent annual growth rate in accordance with information provided by the City. The projected population in the design year (2045) is 48,400.

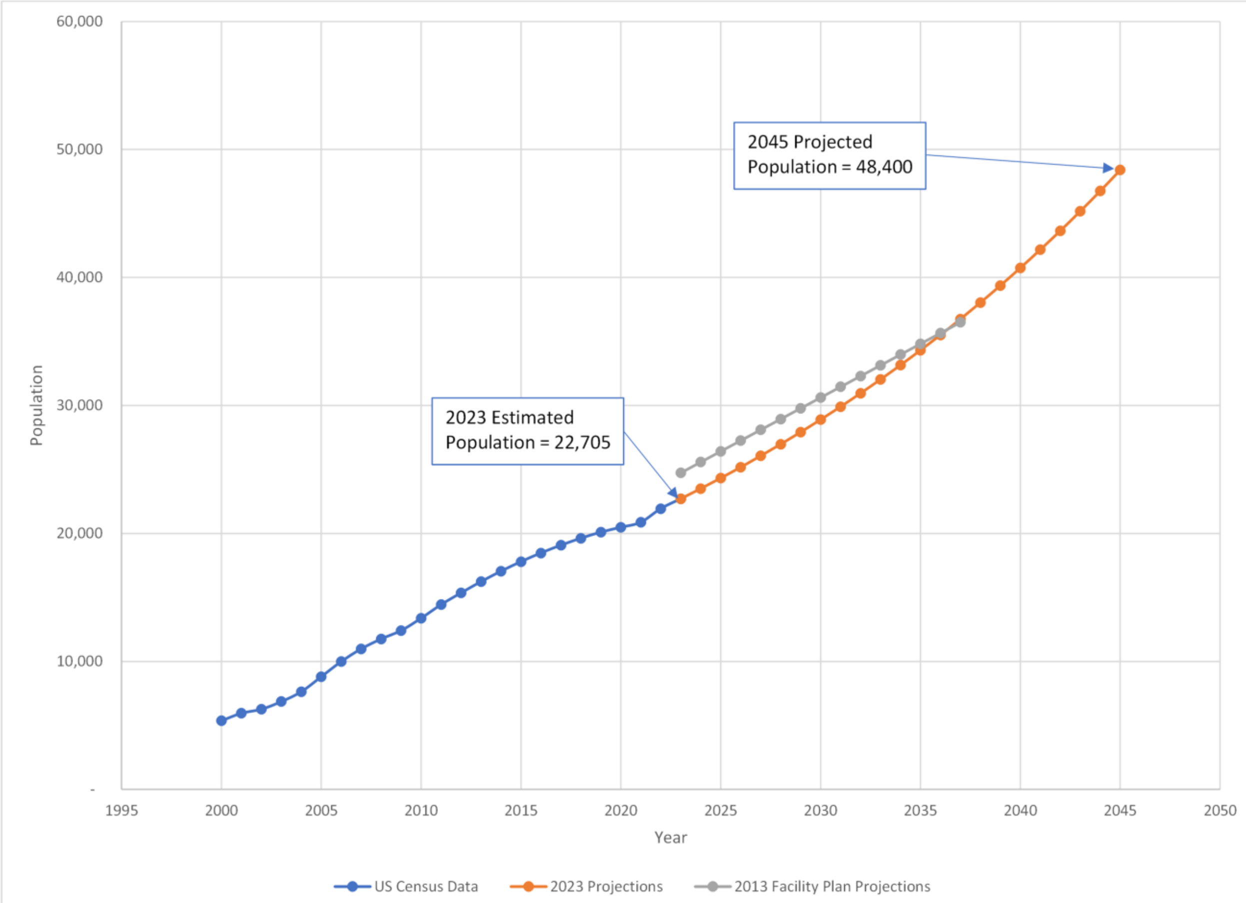

Figure 2.02-1 Population Growth

2.03 EXISTING WATER DEMANDS

Table 2.03-1 presents the historical water use in the City from 2000 through 2023. The water consumption data represents the volume of treated water pumped into the water system from the WTP, including water demand, water sales, and losses due to factors such as leakage. It does not include water uses within treatment processes prior to pumping into the system, such as membrane reject water. The table includes water use and per capita water use for average and peak days each year.

Additionally, the peak to average day water use ratio was evaluated. Both average and peak day per capita use has significantly declined over the past two decades. This trend was also observed in the *2013 Water System Facility Plan*, and per capita water use has only declined more in the past 10 years. This trend is likely due in large part to modern water conservation efforts, like low-flow fixtures and appliances, as well as administrative decisions on the part of the City. For example, the City bills wastewater based on metered water use and does not deduct water use for irrigation or other uses with a second meter.

Year	Estimated Population	ADD (gpd)	PDD (gpd)	Average Per Capita Use (gpcd)	Peak Per Capita Use (gpcd)	Peak:Average Ratio
2000	5,367	447,251	838,000	83	156	1.9
2001	5,957	497,433	938,000	84	157	1.9
2002	6,268	474,003	849,000	76	135	1.8
2003	6,866	561,378	989,000	82	144	1.8
2004	7,637	614,492	1,053,000	80	138	1.7
2005	8,806	738,852	1,443,000	84	164	2.0
2006	9,993	791,589	1,552,000	79	155	2.0
2007	10,983	819,060	1,759,000	75	160	2.1
2008	11,761	819,459	1,321,000	70	112	1.6
2009	12,413	853,490	1,383,000	69	111	1.6
2010	13,374	929,660	1,395,000	70	104	1.5
2011	14,437	1,002,595	1,579,000	69	109	1.6
2012	15,356	1,140,708	1,799,000	74	117	1.6
2013	16,236	1,243,019	2,127,000	77	131	1.7
2014	17,048	1,095,901	1,599,000	64	94	1.5
2015	17,797	1,141,799	1,652,000	64	93	1.4
2016	18,471	1,230,314	1,762,000	67	95	1.4
2017	19,081	1,326,431	2,380,000	70	125	1.8
2018	19,624	1,238,185	2,829,000	63	144	2.3
2019	20,099	1,294,830	2,601,000	64	129	2.0
2020	20,479	1,268,883	2,032,000	62	99	1.6
2021	20,875	1,268,490	1,842,000	61	88	1.5
2022	21,938	1,228,844	1,686,000	56	77	1.4
2023	22,705	1,290,189	1,967,000	57	87	1.5

Notes:
gpd=gallons per day
gpcd=gallons per capita per day
ADD=average day demand
PDD=peak day demand

Table 2.03-1 Historical Water Use

Through review of the PDD data, PDD points were removed from the data set in 2013, 2017, 2018, and 2019 to ensure that peak day values were reflective of real water demands in the distribution system. The rational for removing these data points follows. Data presented in Table 2.03-1 does not include the peak day data eliminated through this evaluation.

A. 2013

The top 6 peak days in 2013 occurred within the first 11 days of September when an average of 1.1 MGD was recovered from the aquifer and storage recovery (ASR) well to ensure all water injected earlier in the year was recovered before beginning the next injection cycle during lower demand months. Because of the operation of the ASR, the total finished water pumped to the distribution system (sum of the WTP high service pumpage and ASR well recovery) was not reflective of the demand in the distribution system; therefore, the peak days for total pumpage to the distribution system that occurred in September 2013 were eliminated from this evaluation. The resulting peak day of 1.8 MGD occurred on July 19, 2013.

B. 2017

Like 2013, the PDD in 2017 occurred at the end of the ASR well recovery season in September 2017, so the total reported pumpage to the distribution system (WTP and ASR well) was not reflective of the system demand. The September 25, 2017, reported PDD of 2.38 MGD was eliminated from the data set for this evaluation. The resulting PDD in 2017 occurred on June 12 and was 1.909 MGD.

C. 2018

The PDD in 2018 occurred on July 13 and was 2.829 MGD. In discussion with City operators, the increased pumpage to the distribution system was attributed to an operational issue at the WTP on the previous day. This is supported by a much higher raw water supply total on the previous day than the finished water pumpage (2.48 MGD raw supply versus 1.134 MGD pumpage to the distribution system). The July 13, 2028, reported peak day was also more than 0.5 MGD greater than the next highest reported day; therefore, this data point was eliminated from this evaluation. The next highest peak day occurred on June 6, 2018, and was 2.174 MGD.

D. 2019

The top 30 peak days reported in 2019 ranged from 1.888 to 2.601 MGD and occurred in March and April due to high injection rates to the ASR well. Ideally, injection into the ASR well occurs at a constant rate over approximately 8 months between September and May. In 2019, ASR well injection only occurred in March and April, which is illustrated in Figure 2.03-1. The operation of the ASR well artificially inflated the source entry point (SEP) pumpage rates, so they were not reflective of distribution system demand. These data points were eliminated from consideration in this evaluation. The resulting peak day in 2019 occurred on July 15 and was 1.862 MGD.

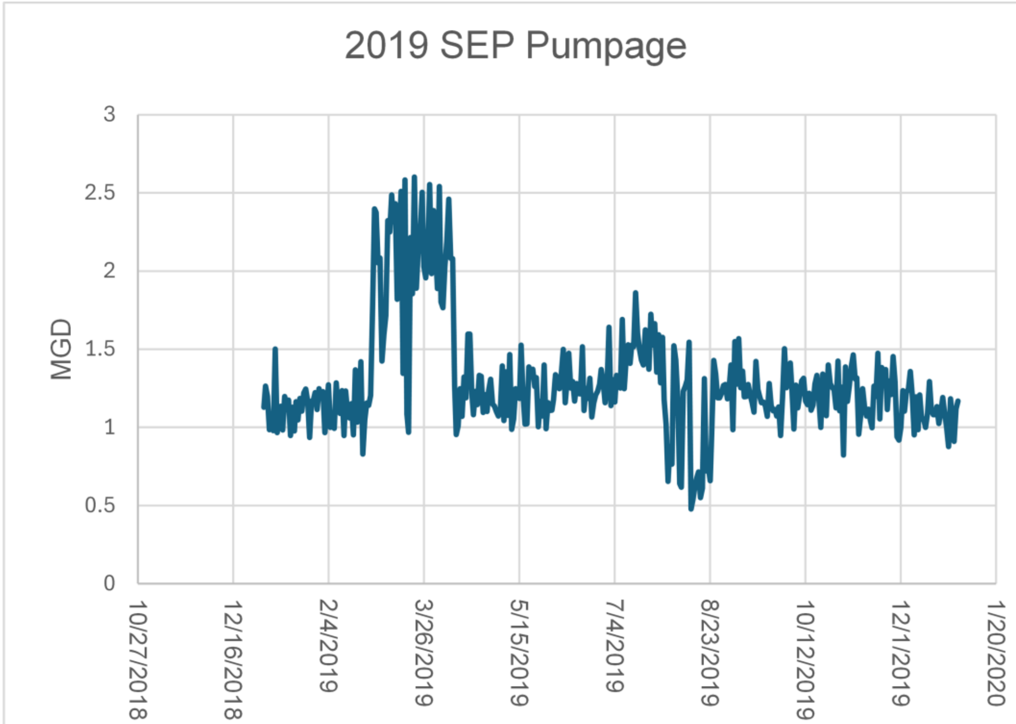

Figure 2.03-1 2019 SEP Pumpage

Figure 2.03-2 presents the per capita water use observed in the City from 2000 to 2023 with elimination of the peak days in 2013, 2017, 2018, and 2019 noted previously. Both peak per capita water use and average per capita water use saw a sharp decline in approximately 2008, when the City made the administrative change to not deduct water use for irrigation from wastewater billing. Peak and average per capita use have seen a steady decline since that point. Both peak and average per capita water use are important figures to consider and evaluate for the purposes of this study. Peak per capita water use is used to estimate future peak water demands and determine required water production needs and plant capacity. Average per capita water use is used to estimate future average water demands to determine storage needs.

Between 2018 and 2023, peak per capita use did not exceed 111 gpcd, and the mean peak per capita use was 93 gpcd. The Iowa Department of Natural Resources (IDNR) suggests the use of 200 gpcd to estimate peak water demand, but it was decided during the *2013 Water System Facility Plan* that reducing the City's peak per capita water use to 150 gpcd for the purpose of water demand projections would be appropriate. For this Facility Plan, a peak per capita water use of 120 gpcd will be used for projecting future PDDs; 120 gpcd is inclusive of future demands related to the University of Iowa (UI) Health Care North Liberty Campus, which is expected to open in 2025 with a projected demand of 120,000 gpd.

During the same time frame of 2018 to 2023, average per capita water use was 61 gpcd. IDNR suggests the use of 100 gpcd to estimate average water demand, but it was decided during the 2013 study that reducing the City's average per capita use to 80 gpcd would be appropriate based on historical water use data. For this study, the average per capita water use of 70 gpcd will be used for projecting future average water demands based on continued decreasing ADDs.

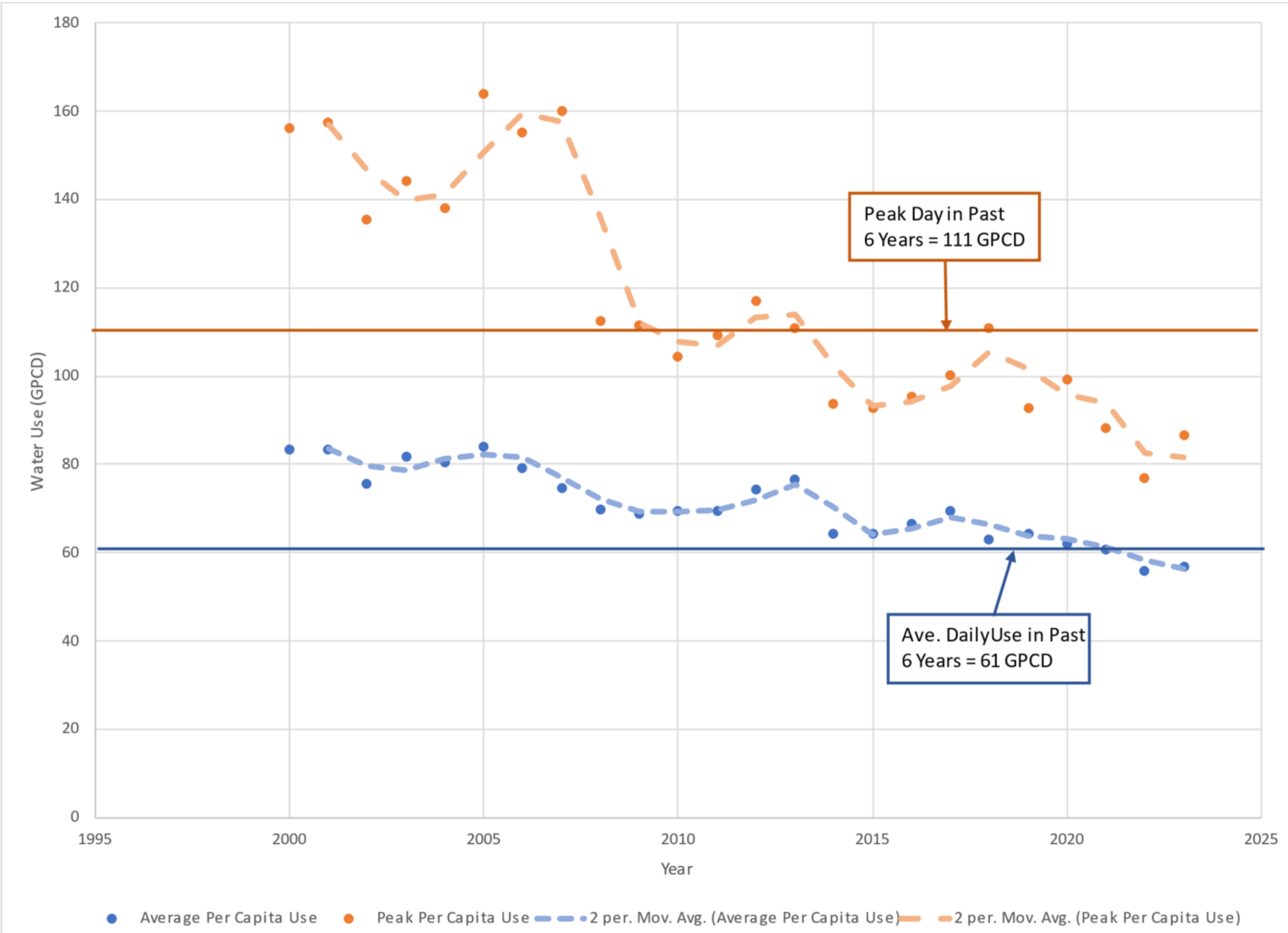

Figure 2.03-2 Per Capita Water Use 2000 to 2023

2.04 PROJECTED FUTURE WATER DEMANDS

Figure 2.04-1 presents the historical PDDs and ADDs from 2000 to 2023, and projected peak and average water uses given the per capita values used in this study (120 and 70 gpcd, respectively) through the design year (2045).

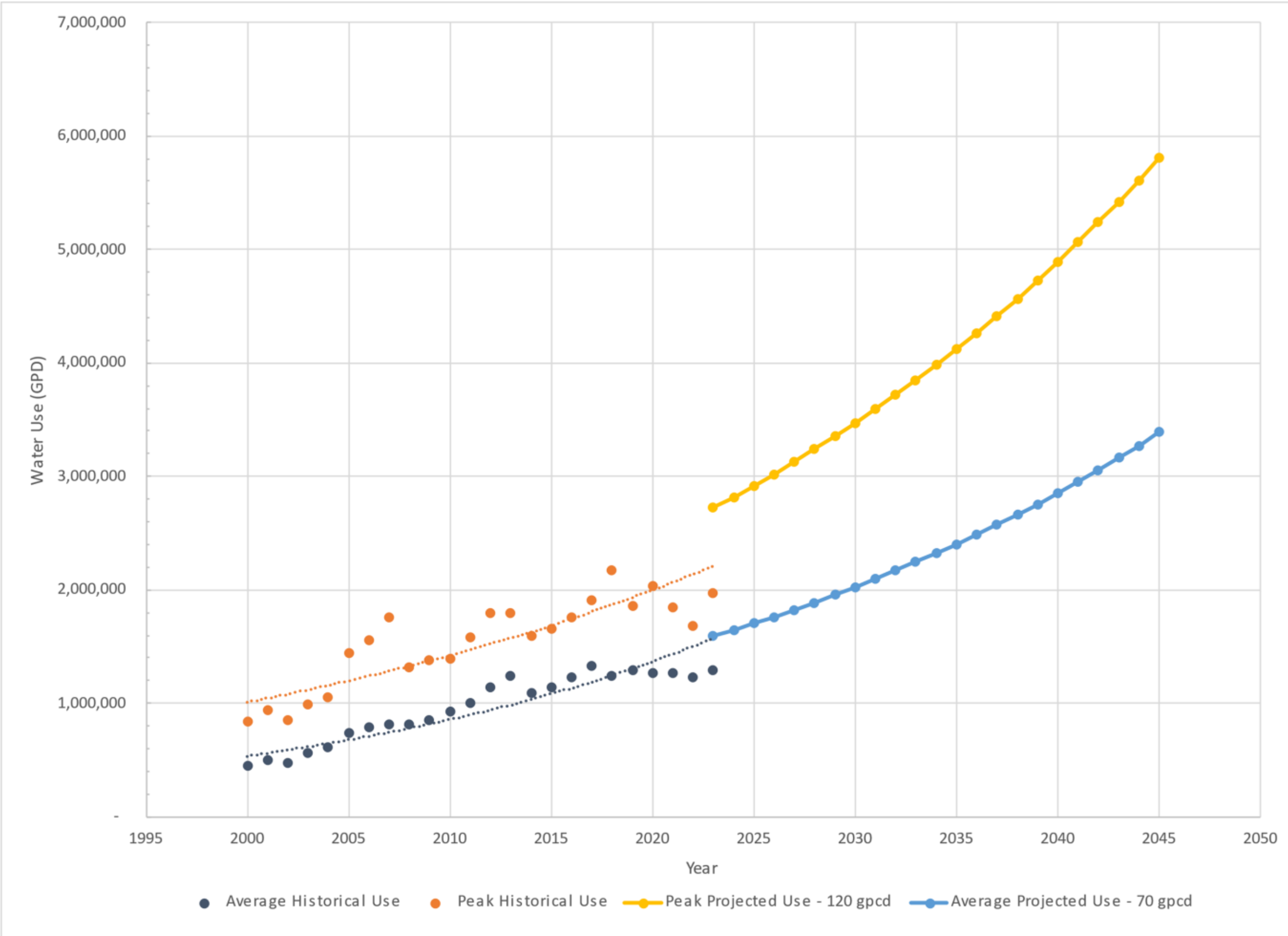

Figure 2.04-1 Projected Water Use

Table 2.04-1 presents projected water demands that were presented in the *2013 Water System Facility Plan* and revised demands based on updated population projections in this report. It is important to note that the actual population growth rate may occur at a faster or slower rate than assumed within this Facility Plan and the best way to refer to future water use projections is in terms of future population, although reference will also be made to a design year throughout this report to provide a basis for future planning. For the design year (2045) population of 48,400 persons, the projected ADD is approximately 3.39 MGD and the projected MDD is approximately 5.81 MGD. These projected demands will be the basis for which WTP, water supply well, and distribution system improvements will be planned in this Facility Plan.

Year*	2013 and 2016 Facility Plan Projections			2024 Projections			
	Population	Annual Average (gpd)	Peak Day (gpd)	Population	Population Percent Change from 2013 Projection (%)	Average Day @ 70 gpcd (gpd)	Peak Day @ 120 gpcd (gpd)
2023	*24,740*	*1,979,000*	*3,711,000*	22,710	(8.2)	1,590,000	2,725,000
2024	*25,580*	*2,046,000*	*3,837,000*	23,500	(8.1)	1,645,000	2,820,000
2025	*26,420*	*2,114,000*	*3,963,000*	24,320	(7.9)	1,702,000	2,918,000
2026	*27,260*	*2,181,000*	*4,089,000*	25,170	(7.7)	1,762,000	3,020,000
2027	*28,100*	*2,248,000*	*4,215,000*	26,060	(7.3)	1,824,000	3,127,000
2028	*28,940*	*2,315,000*	*4,341,000*	26,970	(6.8)	1,888,000	3,236,000
2029	*29,780*	*2,382,000*	*4,467,000*	27,910	(6.3)	1,954,000	3,349,000
2030	*30,620*	*2,450,000*	*4,593,000*	28,890	(5.6)	2,022,000	3,467,000
2031	*31,460*	*2,517,000*	*4,719,000*	29,900	(5.0)	2,093,000	3,588,000
2032	*32,300*	*2,584,000*	*4,845,000*	30,950	(4.2)	2,167,000	3,714,000
2033	*33,140*	*2,651,000*	*4,971,000*	32,030	(3.3)	2,242,000	3,844,000
2034	*33,980*	*2,718,000*	*5,097,000*	33,150	(2.4)	2,321,000	3,978,000
2035	*34,820*	*2,786,000*	*5,223,000*	34,310	(1.5)	2,402,000	4,117,000
2036	*35,660*	*2,853,000*	*5,349,000*	35,510	(0.4)	2,486,000	4,261,000
2037	*36,500*	*2,920,000*	*5,475,000*	36,750	0.7	2,573,000	4,410,000
2038	*37,340*	*2,990,000*	*5,600,000*	38,040	0	2,663,000	4,565,000
2039				39,370		2,756,000	4,724,000
2040				40,750		2,853,000	4,890,000
2041				42,180		2,953,000	5,062,000
2042				43,650		3,056,000	5,238,000
2043				45,180		3,163,000	5,422,000
2044				46,760		3,273,000	5,611,000
2045				**48,400**		**3,388,000**	**5,808,000**
2046				50,090		3,506,000	6,011,000
2047				51,840		3,629,000	6,221,000
2048				53,660		3,756,000	6,439,000
2049				55,540		3,888,000	6,665,000
2050				57,480		4,024,000	6,898,000

Notes:
*Design year 2045 (listed in **bold**).
Previous projections are listed in *italics*.

Table 2.04-1 Projected Water Demands

2.05 PROJECTED FUTURE TREATMENT REQUIREMENTS

Currently, peak water demands can be met through firm capacity finished water production from the WTP (2.96 MGD) as well as recovery from the ASR well (1.32 MGD). Future Phase 1A, Phase 2, and Phase 3 expansions at the WTP (see Section 5) can expand the WTP capacity to 3.23, 4.65, and 5.81 MGD, respectively. Based on the projected demands presented in Section 2.04, the anticipated timing when demand will reach the design capacity for each treatment expansion phase is presented in Table 2.05-1 and Figure 2.05-1. In Section 4 of this report, the option of converting the ASR well to a supply well is discussed. In that case, only the WTP capacity will be available for meeting PDDs.

Table 2.05-2 and Figure 2.05-2 show projected timing when demand exceeds the design capacity of the WTP alone (without the ASR well in service).

With the ASR well in service, the existing WTP could meet projected peak demand through year 2036 and the Phase 2 expansion could meet peak demand through year 2045. Converting the ASR well to a water supply well reduces the total finished water supply available to pump to the distribution system. Without the ASR well in operation, the projected PDD will reach the existing design capacity of the WTP (Phase 1) by 2025, Phase 1A by 2027, and Phase 2 by 2038. To meet the 2045 projected peak demand, Phase 3 expansion would be needed.

Treatment Expansion Phase**	Treatment Capacity		ASR Well Capacity	Firm Finished Water Supply	Year Estimate	Population Estimate	Projected Water Demand	
	Total (MGD)	Firm (MGD)	(MGD)	(MGD)			Annual Average (MGD)	Peak Day (MGD)
Phase 1 (Existing)	3.17	2.96	1.32	4.28	2036	35,510	2.49	4.26
Phase 1A*	3.49	3.23	1.32	4.55	2037	36,750	2.57	4.41
Phase 2	4.65	4.65	1.32	5.97	2045	48,400	3.39	5.81

*Expansion of existing membrane skids by 10 percent.
**Ultimate buildout to Phase 3 projected beyond 20-year design period.

Table 2.05-1 Projected Timing of Reaching WTP Capacity with ASR Well

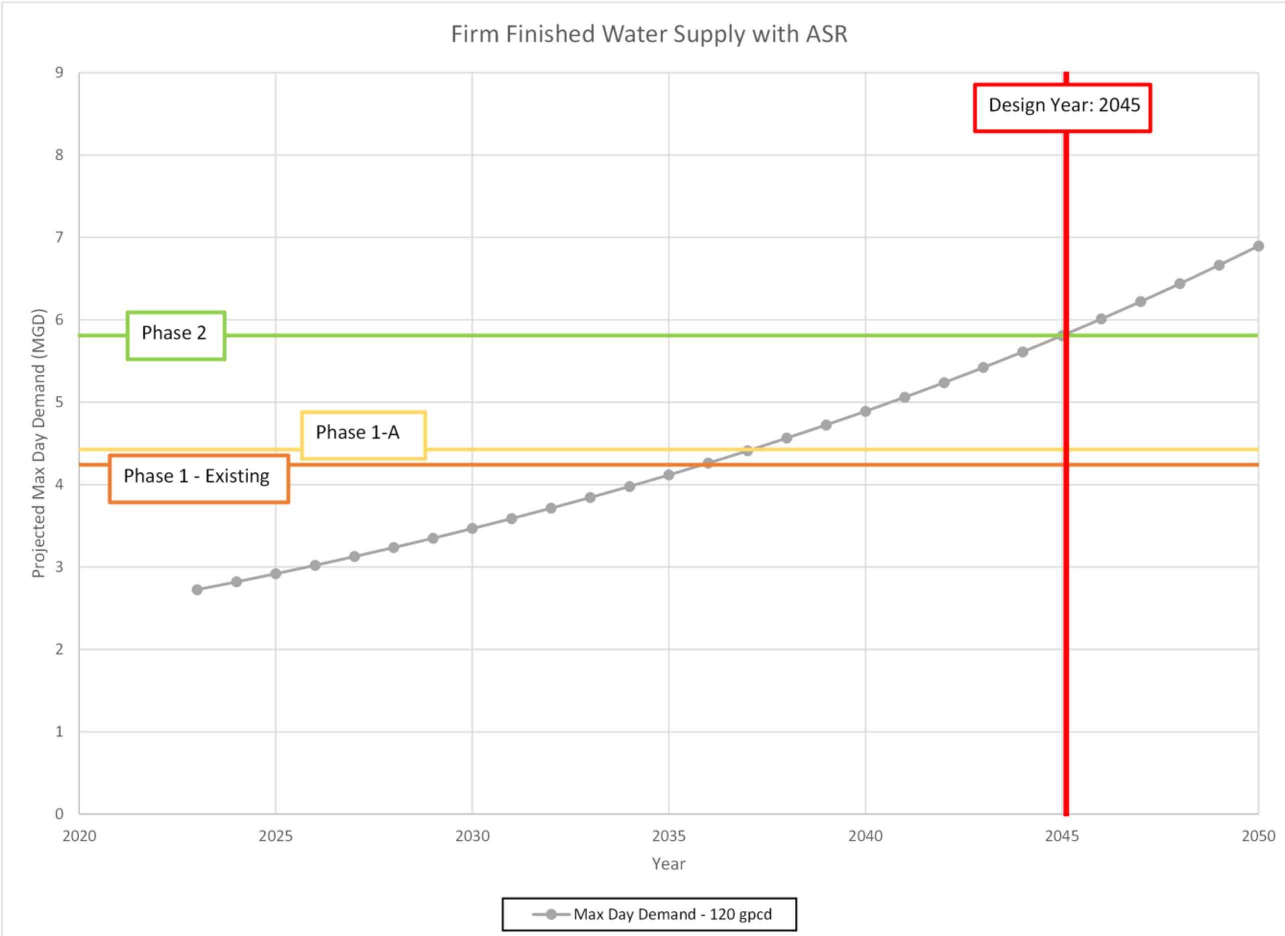

Figure 2.05-1 Projected Timing of WTP Expansions with ASR Well

Treatment Expansion Phase	Treatment Capacity Total (MGD)	Treatment Capacity Firm (MGD)	ASR Capacity (MGD)	Firm Finished Water Supply (MGD)	Year Estimate	Population Estimate	Projected Water Demand Annual Average (MGD)	Projected Water Demand Peak Day (MGD)
Phase 1 (Existing)	3.17	2.96	0	2.96	2025	24,320	1.70	2.92
Phase 1A*	3.49	3.23	0	3.23	2027	26,060	1.82	3.13
Phase 2	4.65	4.65	0	4.65	2038	38,040	2.66	4.57
Phase 3	5.81	5.81	0	5.81	2045	48,400	3.39	5.81

*Expansion of existing membrane skids by 10 percent.

Table 2.05-2 Projected Timing of Reaching WTP Capacity without ASR Well

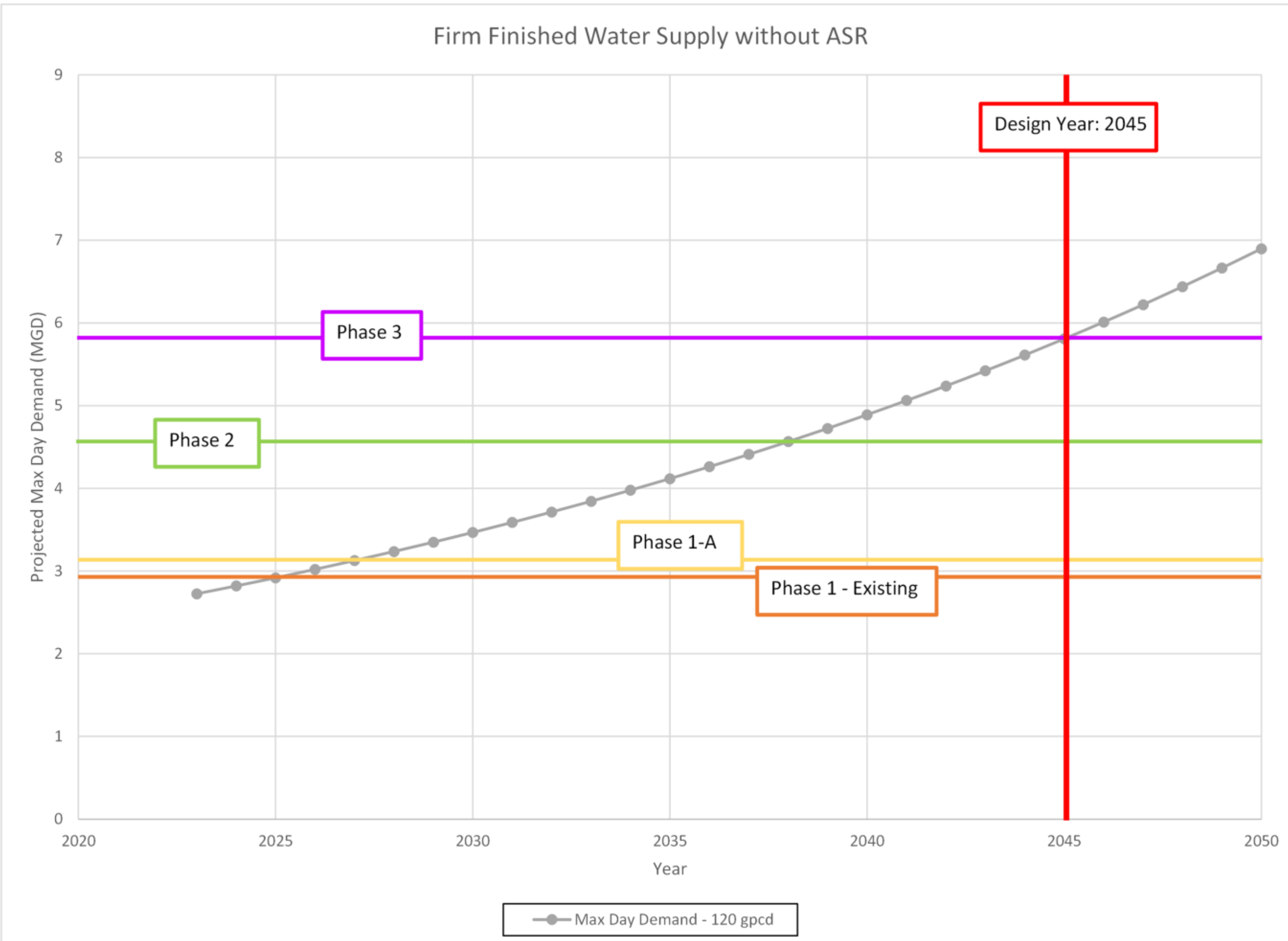

Figure 2.05-2 Projected Timing of WTP Expansions without ASR Well

Detailed discussion of the existing treatment system is included in Section 3. Section 4 includes a detailed discussion on the conversion of the ASR well, and detailed discussion of improvements required for each phased expansion is presented in Section 5.

2.06 TREATMENT REGULATIONS AND CODES

The City is subject to the Federal Safe Drinking Water Act (SDWA) and regulations issued by the IDNR and the United States Environmental Protection Agency (USEPA). The City currently meets these required quality standards and goes beyond the required standards to provide its customers with a softened water supply. The options considered for expansion and or replacement of the existing supply and treatment facilities will be developed based on the premise that the water quality will continue to be as good as or better than current quality and will continue to meet the required primary drinking water standards.

SECTION 3
EXISTING SYSTEM AND FACILITIES

3.01 WATER SYSTEM OVERVIEW

The City owns and operates a water system consisting of six active local groundwater supply wells drawing from the Jordan and Silurian aquifers, an NF membrane WTP, 2.15 million gallons (MG) of finished water storage capacity, an ASR well, and a water distribution and transmission system that spans the City limits. This section summarizes the City's existing water system and facilities and potential deficiencies to be addressed in this Facility Plan.

3.02 GROUNDWATER SUPPLY

The City currently draws raw water supply from six wells: Well Nos. 3, 4, 5, 6, 8, and 9. Well Nos. 1 and 2 are abandoned and are no longer in use. Three wells (Well Nos. 3, 4, and 9) draw from the Silurian aquifer. Three wells (Well Nos. 5, 6, and 8) draw from the Jordan aquifer. Well No. 5 was recased, and Well No. 8 was acidized within the past few years. The City also has one ASR well (Well No. 7). The ASR well is discussed in Section 3.04 and is not included in the current raw water capacity. Well Nos. 3 and 4 are approximately 40 years old and have significantly lower capacity compared to Well No. 9, which is also a Silurian well. As Well Nos. 3 and 4 near the end of their useful life, they could be taken out of service or abandoned during the 20-year planning period. This Facility Plan will consider raw capacity without Well Nos. 3 and 4 in service.

Table 3.02-1 summarizes well information. The existing wells have a total capacity of 3,400 gallons per minute (gpm). The total capacity with Well Nos. 3 and 4 out of service is 3,320 gpm, and the firm capacity without Well Nos. 3 and 4 is 2,220 gpm with the largest well out of service (Well No. 8) and without including Well No. 7.

Well No.	Year Installed	Depth (feet)	Casing Diameter (inches)	Formation	Current Capacity (gpm)
3	1984	502	8	Silurian	30
4	1988	500	8	Silurian	50
5	1994	1,717	12	Jordan	920
6	2001	1,820	18 OD	Jordan	1,000
7	2009	1,675	24	Jordan	NA
8	2017	1,710	24 OD	Jordan	1,100
9	2017	485	12	Silurian	300
Total Capacity					**3,400**
Firm Capacity					**2,300**
Total Capacity (excluding Well Nos. 3 and 4)					**3,320**
Firm Capacity (excluding Well Nos. 3 and 4)					**2,220**

OD=outside diameter
NA=not applicable

Table 3.02-1 Raw Water Supply Summary

With one well out of service and the WTP operating 24 hours per day, the existing firm water supply capacity would only be able to support operation of two NF skids. With the existing firm capacity of 2,300 gpm (with Well Nos. 3 and 4 in service), in 24 hours of operation the treatment capacity would be 2.96 MGD and would require bypassing approximately 32 percent raw water, resulting in a finished water blended hardness of 152 milligrams per liter (mg/L). The existing firm raw water capacity is also not sufficient to meet the current 3.02-MGD rated treatment capacity.

Figure 3.02-1 shows the location of the wells and the WTP within the City. The raw water quality summary for each of the Silurian and Jordan wells is summarized in Table 3.02-2.

Parameter	Unit	Silurian Wells			Jordan Wells		
		Well No. 3	Well No. 4	Well No. 9	Well No. 5	Well No. 6	Well No. 8
pH	-	7.15	7.18	7.33	7.38	7.34	7.47
Total Dissolved Solids	mg/L	810	790	910	1,050	1,040	1,020
Sulfate	mg/L	320	310	450	530	530	470
Chloride	mg/L	2.2	1.2	4.6	36	30	30
Fluoride	mg/L	0.3	0.28	0.38	1.4	1.3	1.4
Nitrate (as N)	mg/L	<0.250	<0.250	<0.250	<0.250	<0.250	<0.250
Total Hardness	mg/L	580	520	510	440	440	470
Sodium	mg/L	40	41	92	150	140	140
Combined Radium	pCi/L	3.3	2.1	4.6	6	6.2	3.8
Iron	mg/L	0.38	0.04	0.27	0.06	0.14	0.53

pCi=picocuries per liter

Table 3.02-2 2023 Raw Water Quality Summary per Well

3.03 WTP

The City operates an NF WTP, consisting of three NF skids, that was constructed in 2018 with a design capacity of 3.02 MGD based on 20 hours per day of operation, 85 percent recovery from the NF WTP, 16.6 percent bypassed, and a finished water blended hardness of approximately 82 mg/L. The City has bypassed more water and operated at a higher blended hardness of up to 100 mg/L. Normal operation, which is defined as 20 hours of operation per day with 20.5 percent bypass to produce 100 mg/L blended hardness, can currently produce 3.17 MGD of finished water.

Each NF skid has an additional 10 percent capacity that can be built to maximize treatment from each skid. Finished water capacity could be increased to 3.49 MGD by building out each existing skid by an additional 10 percent.

For future expansion, space is available for adding additional NF skids of the same size during the Phase 2 and 3 WTP expansions, respectively, for an ultimate buildout of five NF skids with the Phase 3 WTP expansion. The WTP also includes aeration, high service pumping, chemical feed systems, and a ground storage reservoir.

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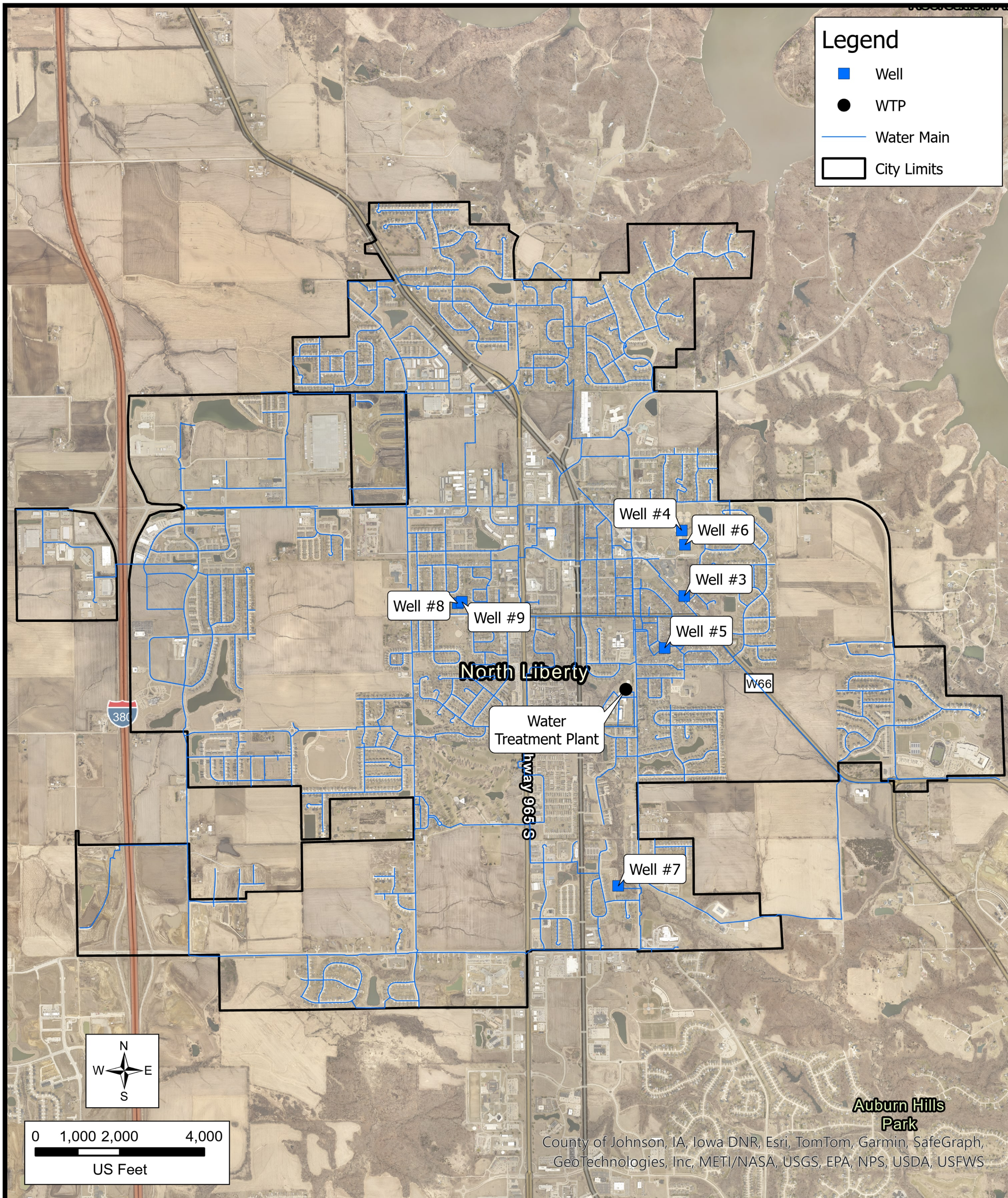


EXISTING WELL LOCATIONS

WATER SYSTEM FACILITY PLAN
CITY OF NORTH LIBERTY
JOHNSON COUNTY, IOWA

STRAND ASSOCIATES®

FIGURE 3.02-1
7037.013

A. NF System

The existing NF system was constructed and put into operation in 2018 after a successful pilot study that was completed in 2014. The system consists of three NF trains (skids), each designed to produce 700 gpm permeate. The system is designed with a 16 by 8 array and seven element pressure vessels, for a total of 168 membrane elements. Each element has a 400-square-foot (sf) membrane surface area, for a total membrane surface area of 67,200 sf. The membrane type is Dow Filmtec™ NF90-400. At 700 gpm per train, the average flux is 15 gallons per square foot per day. Each skid is sized to allow for additional pressure vessels to be added to increase permeate flow by 10 percent to a total of 770 gpm per skid in the future. Water quality from each NF train is summarized in Table 3.03-1.

Figure 3.03-1 NF Skid

Parameter	Units	Concentration		
		Train No. 1	Train No. 2	Train No. 3
pH	-	5.94	5.93	5.93
Total Dissolved Solids	mg/L	22	28	18
Sulfate	mg/L	2.0	2.3	2.0
Chloride	mg/L	3.4	3.8	2.4
Fluoride	mg/L	<0.10	<0.10	<0.10
Nitrate (as N)	mg/L	<0.250	<0.250	<0.250
Total Hardness	mg/L	<5	<5	<5
Sodium	mg/L	6.4	6.7	6.5
Combined Radium	pCi/L	<1	<1	<1
Iron	mg/L	<0.02	<0.02	<0.02

Table 3.03-1 2023 Permeate Water Quality Summary per Train

The NF treatment system includes low service pumps and pretreatment with cartridge filters to protect membranes against particulate matter.

Permeate from NF treatment is blended with raw bypass water at an approximate ratio of 20 percent bypass to 80 percent permeate so that finished water hardness does not exceed 100 mg/L. The percentage of raw water bypassed can be increased if an NF skid is out of service to reach peak day capacity.

The City has noted a higher number of incidents of water discoloration when a relatively higher percentage of Silurian water is bypassed. Despite this, the average concentration of iron in the City's Silurian wells (Well Nos. 3, 4, and 9) was 0.23 mg/L in 2023, whereas the average concentration of iron in the City's Jordan wells (Well Nos. 5, 6, and 8) was 0.24 mg/L in 2023. Most of the water that is currently bypassed during normal operation is Jordan water. Water discoloration due to iron oxidation is occasionally observed in the distribution system through customer complaints in areas of the system that contain older water. Some of the water quality issues in the distribution system have been corrected through elimination of dead-end water mains and by changing the phosphate blend fed in the WTP to a 50/50 polyphosphate/orthophosphate blend in 2020. Even with the change in polyphosphate-orthophosphate blend, some discoloration incidents are still reported.

Concentrate disposal from the NF system is through the sanitary sewer system to the City's wastewater treatment plant.

On November 27, 2023, Komline-Harn conducted on-site annual maintenance and calibration of the NF treatment system and instrumentation. The feed pumps and antiscalant system components were found to be operating without issue. Control panels and instruments were found to be in good condition, and all three trains were operating nominally. No additional cleaning was recommended. For Komline-Harn's detailed maintenance report, reference Appendix A. Komline-Harn typically expects membranes to last between 5 to 10 years but has seen membranes at some sites that have lasted

20 years. The existing membranes are 6 years old. If the system is maintained free of leaks and any leaks that arise are fixed, which is important with metals (specifically iron), then Komline-Harn expects the existing membranes to last until 2027 to 2030. If metals (specifically iron) are present and if leaks are not addressed, air may leak in and cause the metals to transition (due to oxidation), membrane damage, and premature replacement.

B. Aeration

The aluminum forced draft aerator located downstream of the NF skids degasifies NF treated water. Aerator is a Westech Equipment model No. AWF31C which has been in service since 2018. It has an area of 10 by 10 feet and a side wall height of 10 feet. The aerator is constructed with an 18-inch inlet pipe and a 14-inch outlet pipe, and has a rated capacity of 2,100 gpm (2.52 MGD in 20 hours). Space is available for adding a second aerator and expanding treatment capacity to 4,200 gpm (5.04 MGD in 20 hours).

The unit includes a 2-horsepower (hp), 230/460-volt, three-phase blower with a capacity of 7,500 standard cubic feet per minute at a head loss of 3/8 inch of water.

Figure 3.03-2 Aerator

C. Chemical Feed

The plant feeds antiscalant to minimize fouling and scaling in the NF membrane system, sodium hypochlorite for disinfection purposes, sodium hydroxide (caustic) for pH adjustment, fluoride for tooth decay prevention, and phosphate compounds for protection of water mains and plumbing systems from corrosion and depositions. The City has indicated the potential need for an additional phosphate feed point for iron control in raw bypass water, or an adjustment to the existing phosphate blend to assist in iron control. Potential additions or upgrades increasing capacity to water treatment and chemical feed systems are evaluated in Section 4 of this report. Table 3.03-2 summarizes the existing chemical feed system bulk storage capacities and pumping capacities.

Chemical Name	Concentration (%)	Current Dose (mg/L)	Bulk Storage Capacity (gallons)	Day Storage Capacity (gallons)	Firm Pumping Rate (gph)
Antiscalant (Vitec 3000)	100	2.6	460	30	1.5
Sodium Hypochlorite	12.5	5.3	6,100	155	11.8
Sodium Hydroxide, Caustic	30	16.4	7,800	540	23.0
Fluoride (Hydroflurosilic acid)	24	0.7	155	20	1.5
Phosphate (LPC-4)	36	1.8	460	30	1.5

gph=gallons per hour

Table 3.03-2 Existing Chemical Feed System Summary

1. Antiscalant

An antiscalant is added to the NF system to prevent fouling and scaling. The antiscalant is injected after the bypass line on the feed to the NF skids. The antiscalant feed system was designed to dose up to a feed rate of 1.5 gph. Bulk storage is provided by two 230-gallon tanks and a day tank, as listed in Table 3.03-2.

2. Sodium Hypochlorite, 12.5 Percent Solution

Sodium hypochlorite, 12.5 percent solution, is used for finished water disinfection. There are two chlorine injection points: one after blending the bypass water into the permeate before entering the ground storage reservoir, and the other before the high service pumps that feed the distribution system. The sodium hypochlorite feed system was designed to dose up to a feed rate of 11.8 gph. Bulk storage is provided by one 2,000-gallon tank, one 4,100-gallon tank, and a day tank, as listed in Table 3.03-2.

3. Sodium Hydroxide, Caustic

Sodium hydroxide (caustic) is added to adjust the pH and stabilize blended water. Sodium hydroxide is fed following membrane treatment, degasification, and blending. The feed rate is automatically adjusted based on the process pH. The caustic feed system was designed to dose up to a feed rate of 23.0 gph. Bulk storage is provided by two 3,900-gallon tanks and a day tank, as listed in Table 3.03-2.

4. Fluoride

Fluoride is added to finished water in the form of hydrofluorosilicic acid for dental protection. The fluoride injection point is located on the inlet piping to the high service pumps. The feed rate is automatically controlled based on high service pump rates. The fluoride feed system was designed to dose up to a feed rate of 1.5 gph. Bulk storage is provided by one bulk tank and a day tank, as listed in Table 3.03-2.

5. Phosphate

Phosphate is added to finished water to control corrosion in the distribution system in the form of sodium phosphate. The injection point is located after the bypass and permeate mixing point. The feed rate is automatically controlled based on high service pump rates. The phosphate feed system was designed to dose up to a feed rate of 1.5 gph. Bulk storage is provided by two 230-gallon tanks and a day tank, as listed in Table 3.03-2.

D. Finished Water Quality

The finished water from the City's WTP contains no contaminant that exceeds the maximum contaminant levels (MCL) established by the USEPA or the IDNR, meeting all primary and secondary standards. During normal operation, approximately 80 percent of finished water is treated with the NF system and the remaining 20 percent of raw water supplied to the WTP is bypassed around the NF system and blended with the permeate. No treatment of the bypass water occurs until after it is blended with the permeate. Table 3.03-3 summarizes typical water quality characteristics of the City's finished water supply, as of 2023, after permeate and bypass water is blended. Blending is adjusted to maintain a maximum finished water hardness of 100 mg/L during normal operation. When one NF skid is out of service, the plant design capacity is achieved by increasing the raw water bypass and operating 24 hours per day rather than 20 hours per day.

Parameter	Units	Concentration
pH	-	9.17
Total Dissolved Solids	mg/L	270
Sulfate	mg/L	100
Chloride	mg/L	16
Fluoride	mg/L	0.68
Nitrate (as N)	mg/L	<0.250
Total Hardness	mg/L	98
Sodium	mg/L	47
Combined Radium	pCi/L	1.0
Iron	mg/L	0.04

Table 3.03-3 2023 Finished Water Quality Summary

1. Biological Contaminants

A review of existing water quality provided by the City found no issues with biological contaminants in the finished water. The City provides sodium hypochlorite disinfection of the finished water.

2. Organic Contaminants

A review of existing water quality provided by the City found no issues with organic contaminants in the finished water.

3. Radiological Contaminants

Although Jordan Well Nos. 5 and 6 contain radiological contaminants that exceed drinking water standards, the existing treatment processes reliably reduces these contaminants to safe levels.

4. Inorganic Contaminants

A review of existing water quality provided by the City found no issues with inorganic contaminants in the finished water.

5. Emerging Contaminants

Per- and Polyfluoroalkyl Substances (PFAS) are a category of synthetic organic chemicals that consist of strong carbon-fluoride bonds in long and short chains. The USEPA Final Rule for PFAS, promulgated in April 2024, identifies the risk of health effects that may occur because of the exposure to PFAS in drinking water and the benefit of reducing or eliminating PFAS from public water supplies. USEPA is establishing new rulemaking for six PFAS compounds known to occur individually and/or as mixtures in drinking water.

The City conducted testing for PFAS compounds on its SEP in November 2023. A summary of the test results for the regulated compounds and MCLs for each PFAS chemical regulated under the Final Rule are included in Table 3.03-4. The PFAS compounds tested lower than the quantifiable limit for detection. The calculated Hazard Index is zero since tested compounds were not detected.

PFAS Compound	MCL	Tested SEP Concentration
PFOA	4.0 ppt	<4.0 ppt
PFOS	4.0 ppt	<4.0 ppt
PFHxS	10 ppt	<3.0 ppt
HFPO-DA (GenX chemicals)	10 ppt	<5.0 ppt
PFNA	10 ppt	<4.0 ppt
Mixture of two or more: PFHxS, PFNA, HFPO-DA (GenX) and PFBS	Hazard Index of 1	Not Reported

Notes: All MCLs, maximum contaminant level goals (MCLG) and Hazard Indices are based on a running annual average for each entry point.

PFOA=Perfluorooctanoic acid
ppt=parts per trillion
PFOS=Perfluorooctanesulfonic acid
PFHxS=Perfluorohexanesulfonic acid
HFPO-DA=Hexafluoropropylene oxide-dimer acid
PFNA=Perfluorononanoic acid
PFBS=Perfluorobutanesulfonic acid

Table 3.03-4 PFAS SEP Testing Summary

Silurian and Jordan aquifer water is from confined wells, which are protected from surface water influence. Confined wells are therefore less likely to have positive detection of PFAS compounds unless the wells have been contaminated by other PFAS compound containing sources.

NF can be effective in treating PFAS compounds from water. If positive detection of PFAS compounds is found in the raw water supply in the future, the concentration of PFAS present in the water could limit the amount of water that can be bypassed and then blended with NF treated water. Other treatments that have been demonstrated to reduce PFAS in drinking water include Granular Activated Carbon, Powdered Activated Carbon, PFAS selective ion exchange resin, or developing new source water supplies.

E. Ground Storage Reservoir

The ground storage reservoir is a 750,000-gallon, abovegrade, prestressed, precast concrete tank that sits at the WTP site to the east of the WTP. The reservoir, which has been in service since 2018, stores finished water from the WTP and directly feeds the high service pumps.

The ground storage reservoir consists of two chambers: an inner and outer chamber. The inner and outer chambers have approximately equal volumes and separate inlets and outlets to allow either chamber to be isolated for maintenance while the other chamber remains in service. The water level in each chamber is monitored with ultrasonic level sensors. Each chamber also has single baffle walls to minimize short circuiting of the flow and provide better turnover of the water. The tank also has an overflow piping and vent from each chamber. The ground storage reservoir has an exterior diameter of approximately

85 feet 6 inches, and the interior chamber has a diameter of approximately 60 feet 5 inches. No expansions of water storage facilities at the WTP site are planned.

Figure 3.03-3 Ground Storage Reservoir

F. High Service Pumps

The water system is supplied by three (two plus one reserve) vertical turbine "can-style" pumps located in the WTP. The pumps each have a design capacity of 1,667 gpm (2.0 MGD with 20 hours of runtime per day), and the firm capacity with one pump out of service is 3,334 gpm (4.0 MGD with 20 hours of runtime per day). Pumps each have 150-hp motors. Typically, one pump runs at a time, and the two active pumps are alternated on a weekly basis.

The pumps have been in service since 2018. Pumps are operated to maintain water levels of the distribution system elevated storage tanks (EST) within a set range. The pumps are equipped with variable frequency drives to vary the pumping rate, with the speed being automatically adjusted to achieve the operator-adjustable pumping rate. Pumps are also controlled based on the water level in the ground-level storage tank (GST) and shut off when the GST reaches the low level.

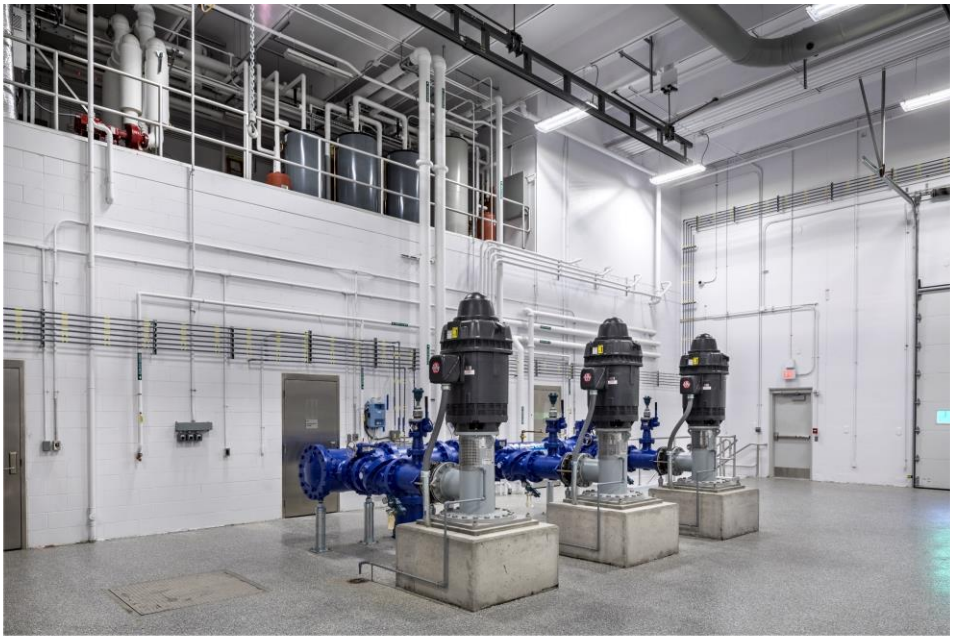


Figure 3.03-4 High Service Pumps

3.04 ASR WELL

The City currently has one ASR well that is constructed in the Jordan aquifer. Construction began for the ASR well 2009, and the first full recovery cycle to the distribution system occurred in August and September 2012.

The ASR well is intended to provide a supplemental supply of water to meet PDDs. The decision to build an ASR well was selected in 2006 as an alternative to expanding the WTP capacity because it offered significant cost savings. The concept of ASR wells is that treated water is stored in underground aquifers during periods of excess water production and then the treated water is pumped back out of the wells during periods of excess water demand.

ASR Well No. 7 was designed for an injection rate of 500 to 900 gpm and a withdrawal rate up to 1,200 gpm. ASR well testing to date shows that the ASR well can operate at an injection rate of 800 gpm and a recovery rate of 1,100 gpm when pumping to the system. Using a small amount of conservatism and assuming a 20-hour available recovery period to allow downtime for maintenance or emergency repair, this results in an available recovery volume of 1.32 MGD from ASR Well No. 7. This capacity can be used to off-set PDDs, provided an adequate volume of treated water can be injected during low demand periods.

The existing ASR well has not been used since 2019. The City wants to consider discontinuing use of the ASR and converting this well into a raw water source. Well No. 7 as a raw water supply is further assessed in Section 4.

3.05 WTP BUILDING AND FACILITY

The WTP is constructed as an approximately 16,400-sf building, which houses the membrane skids, chemical storage and feed systems, low and high service pumps, a control room, laboratory, staff offices, restrooms, a break room, training room, garage and maintenance space, and electrical and mechanical rooms. A detailed evaluation of the building's structural, architectural, heating, ventilation, and air conditioning, sewer and water, site, and electrical components was not performed as a part of this study.

3.06 WATER STORAGE

The water distribution system includes two water towers with volumes of 0.4 and 1.0 MG, respectively, and the ground storage reservoir at the WTP with a volume of 0.75 MG. Table 3.06-1 presents the overflow elevations of each water tower and the ground storage reservoir. The total storage capacity in the system is 2.15 MG.

Storage Type	Year Constructed	Volume (MG)	Overflow Elevation (feet)
Water Tower	1995	0.4	918.35
Water Tower	2007	1.0	915.50
Ground Storage Reservoir	2018	0.75	768.50
Total Storage Volume		**2.15**	

Table 3.06-1 Finished Water Storage Summary

In previous studies, plans were made for additional elevated water storage to be added off-site. Additional storage capacity and future storage needs are discussed in Section 4.

SECTION 4
WATER SUPPLY IMPROVEMENTS

4.01 OVERVIEW

As water demand increases, water supply capacity will also need to expand to keep pace. Water supply capacity increases will be timed to keep up with treatment expansion and provide redundancy required by IDNR.

4.02 WATER USE PERMIT AND JORDAN AQUIFER REGULATIONS

The City has a Water Use Permit issued by IDNR, which allows withdrawal from the Jordan and Silurian aquifers. Revisions to the City's existing Water Use Permit will be needed to meet future projected demands. The existing permit allows for a maximum of 850 MG per year at a maximum pumping rate of 4,100 gpm, split between the Jordan and Silurian aquifers. A maximum of 650 MG per year may be withdrawn from the Jordan aquifer, or an average of 1.78 MGD (1,237 gpm). A maximum of 250 MG per year may be withdrawn from the Silurian aquifer, or an average of 0.685 MGD (475 gpm). The permitted withdrawal should be adequate for the projected 2030 demand.

The State of Iowa (Iowa) has established rules to protect the Jordan aquifer from overuse. The rules establish Tier 1, Tier 2, and Tier 3 pumping levels in Jordan wells. When the Tier 2 level is reached, a site-specific water conservation plan must be developed and submitted to IDNR. Reaching the Tier 3 level requires aggressive water conservation plans that will lead to recovery of the water levels above Tier 3 level. Johnson County is also in a protected source water area. In the protected source water areas, new or modified water use permits will be restricted or denied if necessary to preserve public health and welfare.

The Tier 2 limit for the City's Jordan wells is 300 feet below the 1978 Jordan water level according to the City's water use permit. Figures 4.02-1, 4.02-2, and 4.02-3 show the static and pumping water level for Well Nos. 5, 6, and 8 (Jordan wells) for September 2023 through August 2024. The average pumping water level distance above the Tier 2 level for each well during this period is presented in Table 4.02-1.

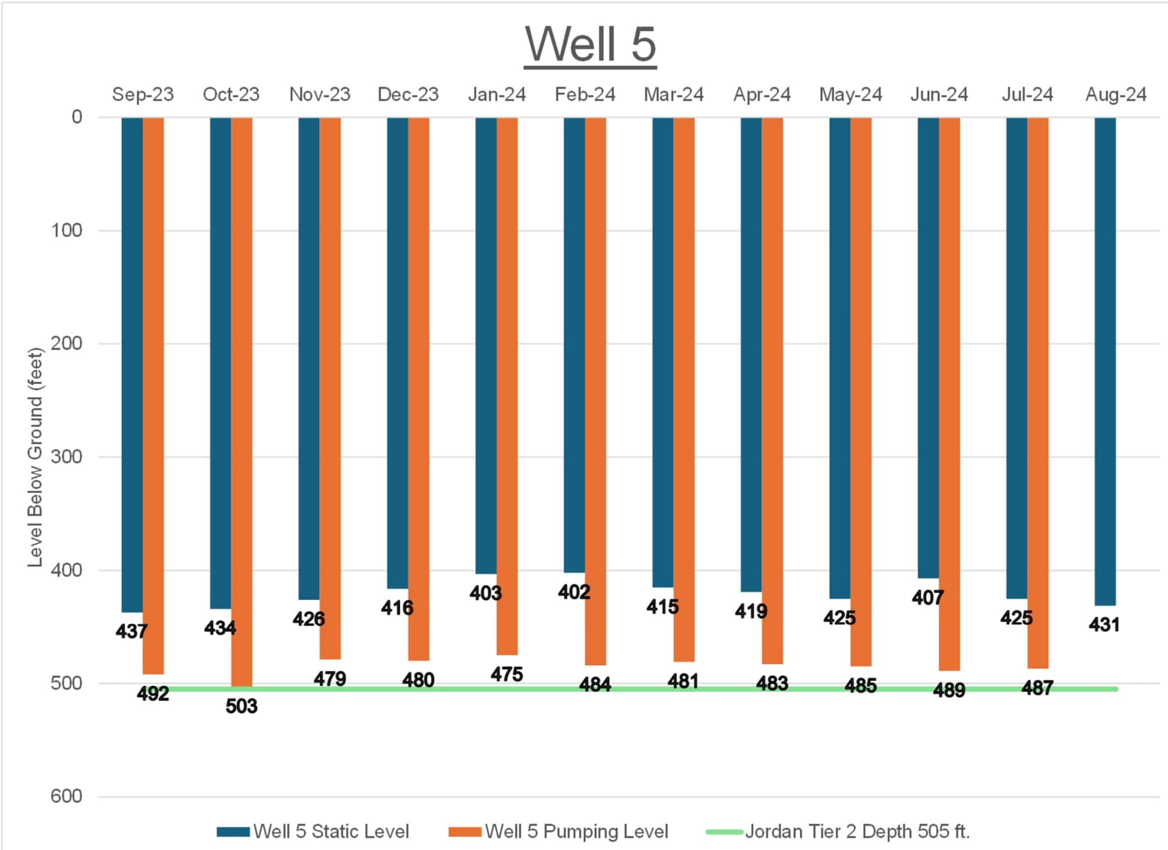


Figure 4.02-1 Well No. 5 Water Levels September 2023 to August 2024

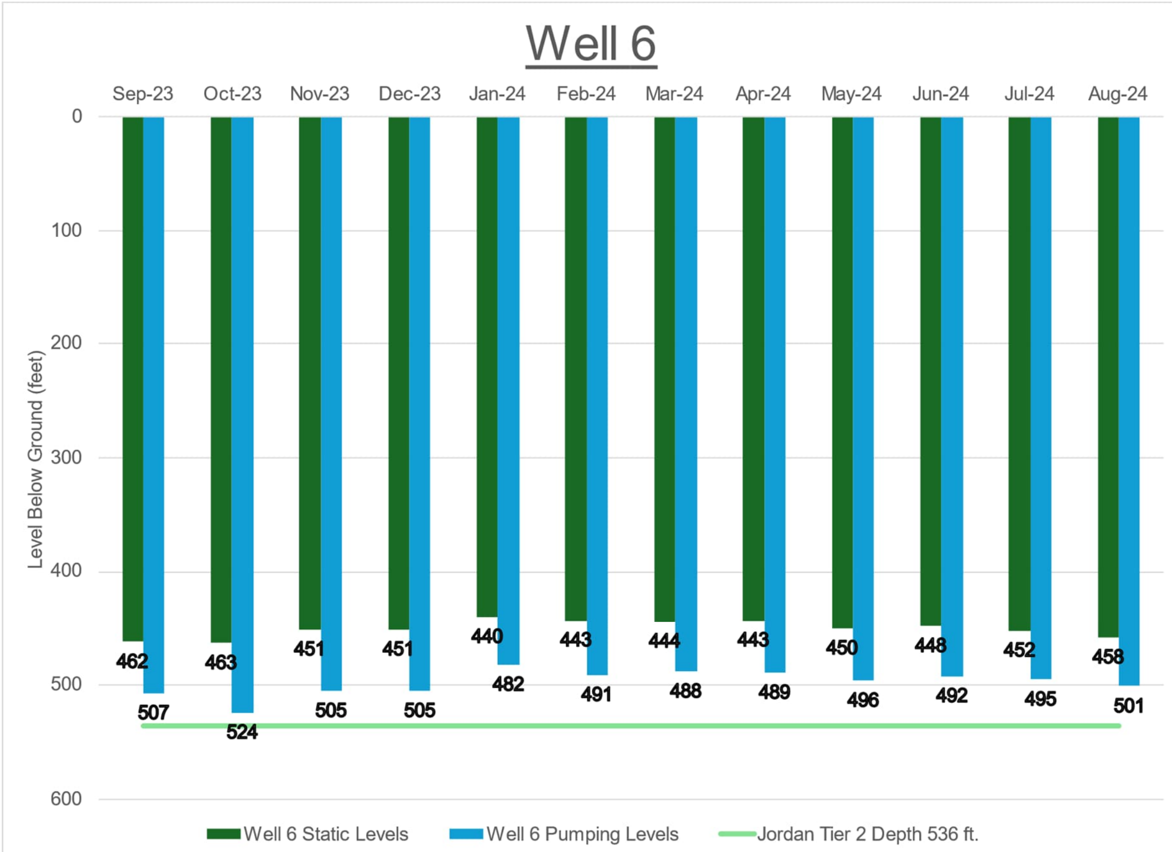


Figure 4.02-2 Well No. 6 Water Levels September 2023 to August 2024

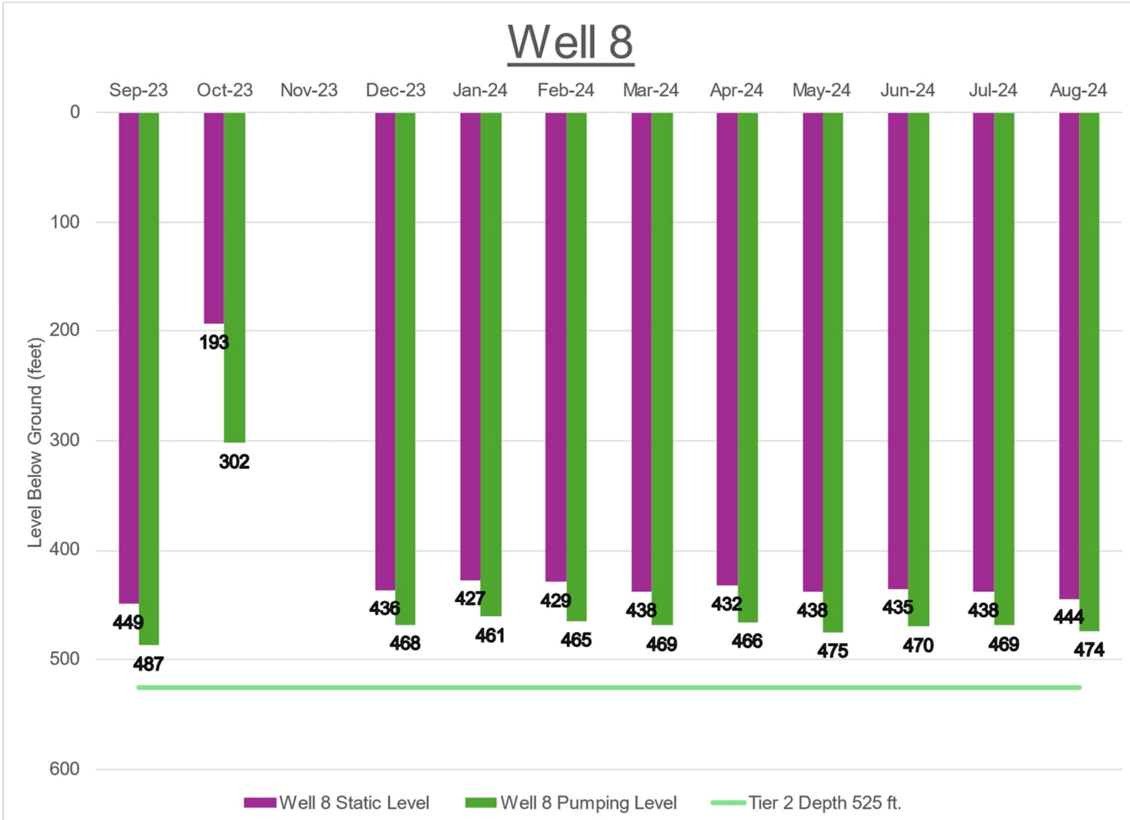


Figure 4.02-3 Well No. 8 Water Levels September 2023 to August 2024

Parameter	Well No. 5	Well No. 6	Well No. 8
Well Elevation (feet)	755	786	775
1978 Jordan Water Level Elevation (feet)	550	550	550
Jordan Tier 2 Depth (feet)	505	536	525
Average Static Water Level Depth (feet)	420	450	414
Average Pumping Water Level Depth (feet)	485	498	455
Feet Above Tier 2 Level During Pumping	**20**	**39**	**70**

Table 4.02-1 Jordan Water Levels September 2023 to August 2024

4.03 CONVERSION OF THE ASR WELL TO A RAW WATER SUPPLY WELL

The ASR well is intended to provide supplemental supply of treated water to meet PDDs, particularly during the warm-weather months. Because the existing WTP can produce enough water to meet PDDs, the City's ASR well is not currently in use. As demands increase, the ASR well (Well No. 7) would need to be placed back in service to meet PDDs. As noted in Section 2, the existing WTP in conjunction with the ASR well could meet PDDs through 2036. The ASR well provides the ability to meet PDDs higher than the WTP capacity. Instead of continuing to maintain the well as an ASR well, one alternative is to repurpose Well No. 7 as a raw water supply well to increase raw water supply as population and water demand increases. By converting the ASR well to a raw water supply well, the available finished water supply would be reduced to the capacity of the WTP; therefore, WTP expansion (Phases 2 and 3) would need to occur sooner. More discussion on the timing of future WTP expansions due to ASR well conversion to a raw water supply well will be discussed in Section 5.

If the ASR well is converted to a water supply well, the City's Water Use Permit would need to be modified to allow increased production from the Jordan aquifer wells to obtain the maximum benefit. Assuming maximizing use of the Silurian aquifer, withdrawal from the Jordan aquifer would need to be increased by approximately 15 percent to 745 MG per year for Phase 2. For Phase 3, it may be possible to reduce withdrawal from the Jordan aquifer as additional Silurian wells are added. The request for additional capacity would be subject to modeling and analysis so IDNR can understand the impact on the Jordan aquifer and other surrounding Jordan wells.

Converting Well No. 7 to a raw water supply well and increasing the permitted annual withdrawal rate from the Jordan aquifer could lower the pumping water levels in the Jordan aquifer wells closer to or below the Tier 2 level. The pumping rate from these wells would then need to be reduced to maintain the pumping water level above the Tier 2 level. However, there may be some benefit to having an additional Jordan supply well and spreading the withdrawal over more wells (i.e., pumping each well at a lower rate to get the same total production). Modeling required by IDNR would help understand the impact of converting Well No. 7 to a supply well and the potential influence on the other Jordan wells.

Strand Associates, Inc.® (Strand) has had some preliminary conversations with IDNR regarding converting the ASR well to a raw water production well. The IDNR will require modeling of the Jordan aquifer to determine whether additional water use from the Jordan aquifer would be allowed. IDNR has stated that it would likely follow the precedence set in the City of Grimes, Iowa (Grimes), when converting an ASR well into a production well. The process followed for Grimes included USEPA allowing Grimes to use the well for production for a few years with an amendment to its ASR well permit noting the intent to convert the well to a production well. After 2 to 3 years, USEPA would then need to adjust the Class V underground injection control permit and would have to approve the conversion.

For the purposes of this analysis, the 1,100-gpm (1.32 MGD in 20 hours) capacity of Well No. 7 is considered available as raw water supply. With the conversion of Well No. 7 into a production well, the raw water supply firm capacity with Well No. 8 out of service increases to 3,220 gpm, excluding Well Nos. 3 and 4. Firm raw water supply needs to support plant operation on a 24-hour-per-day operation basis. By converting Well No. 7 to a supply well, all three existing skids would be able to operate with one well out of service and produce 100 mg/L blended hardness water (85 percent recovery and 20 percent bypass) in a 24-hour-per-day operation. Additional well supply will still be required for any future expansion of the water treatment process.

4.04 WTP RAW WATER SUPPLY NEEDS

Minimum raw water supply needs for the existing WTP capacity (Phase 1) and each WTP expansion are listed in Table 4.04-1. Raw water supply needs for each WTP expansion phase in normal operation with all skids in service are determined for treating to 100 mg/L blended hardness, 85 percent recovery from

NF treatment, and approximately 20 percent bypass water. The table also lists firm raw water supply required to operate with one skid out of service and maintain the water treatment production capacity by adjusting blended water percentage and resulting blended water hardness to allow for operation in 24 hours per day, 85 percent recovery from NF treatment. The additional raw water supply needs described below assume that all existing wells remain in service through the Phase 3 WTP expansion.

	Phase 1 (Existing)	Phase 1A	Phase 2	Phase 3
Normal Treatment Operation*				
Treatment Capacity (MGD)	3.17	3.49	4.65	5.81
Number of Skids in Service	3	3	4	5
Percent Raw Water Bypassed (%)	20.5	20.5	20.5	20.5
Blended Hardness (mg/L)	100	100	100	100
Raw Water Supply Needed (gpm)	3,013	3,314	4,419	5,523
Firm Treatment Operation (One skid out of service)**				
Treatment Capacity (MGD)	2.96	3.23	4.65	5.81
Number of Skids in Service	2	2	3	4
Percent Raw Water Bypassed	31.9	31.3	28.4	23.6
Blended Hardness (mg/L)	152	150	137	114
Firm Raw Water Supply Needed (gpm)	2,300	2,514	3,637	4,578

*Normal treatment in 20 hours of operation
**Firm treatment in 24 hours of operation

Table 4.04-1 Raw Water Capacity Needs per Phase Expansion

A. Phase 1 (Existing)

As described in Section 3.02, the existing firm raw water capacity of 2,300 gpm is sufficient to supply the current WTP capacity. If Well Nos. 3 and 4 are removed from service, as discussed in Section 3.02, then existing firm raw water capacity would be 2,220 gpm. For purposes of this evaluation, it is assumed that Well Nos. 3 and 4 will be out of service within the 20-year design period; therefore, they will not be considered part of the firm raw water supply capacity.

Based on available raw water supply, the maximum firm treatment capacity with two skids in operation is 2.96 MGD and would require bypass of 32 percent raw water and operating to a blended hardness of 152 mg/L. As previously discussed, treatment to a blended hardness of approximately 100 mg/L is how the WTP is currently operated. If additional raw water supply is available, increasing the blended hardness increases the capacity of the plant. The resulting raw water capacities needed for normal operation and firm treatment capacity are listed in Table 4.03-1. One additional Silurian raw water supply well with a 200- to 300-gpm capacity would be needed to provide adequate firm capacity for 3.17 MGD plant production. This well should be completed by 2026, if Alternative No. 1 (described in the following section) is implemented, to maintain firm capacity to meet projected demands. This could be added as a separate project before improvements to treatment or would need to be added with treatment expansion for Phase 1A, as described in the following.

B. Phase 1A

Phase 1A includes expanding capacity of the existing NF skids by 10 percent. This provides firm finished water capacity of 4.55 MGD including the ASR well, which would meet projected demands through 2037. If the ASR well is converted to a supply well (Alternative No. 2), then the firm finished water capacity for Phase 1A is 3.23 MGD, which would meet the projected PDD through year 2027.

Approximately 294 gpm (2,514 gpm required minus 2,220 well firm capacity) of additional raw water supply capacity would be needed to provide the adequate firm capacity. Additional well capacity could be provided by adding two new Silurian wells. For this evaluation, additional Silurian wells are assumed to have a capacity of approximately 200 gpm each.

Table 4.04-2 presents the firm and total raw water capacity with either Well No. 7 remaining as an ASR well and the addition of two Silurian wells (Alternative No. 1), or the conversion of Well No. 7 into a raw water supply well (Alternative No. 2), which adds 1,100 gpm capacity. Either Alternative No. 1 or 2 should be complete by 2026 to maintain production capacity. Modifications needed to convert Well No. 7 to a raw supply will include routing a new raw water main from the well to the WTP and controls improvements. The existing pump will remain in service for pumping raw water supply.

		Capacity After Phase 1A Improvements	
	Existing Capacity	**Alternative No. 1: Well No. 7 as an ASR Well***	**Alternative No. 2: ASR Well Conversion****
Firm Well Capacity (gpm)	2,220	2,620	3,320
Total Well Capacity (gpm)	**3,320**	**3,720**	**4,420**

*Phase 1A Alternative No. 1 includes two additional Silurian wells.
**Phase 1A Alternative No. 2 includes converting Well No. 7 into a raw water production well.

Table 4.04-2 Raw Water Capacity Phase 1A Improvement Alternatives

C. Phase 2

Phase 2 includes adding one additional NF skid. The firm finished water capacity including the ASR well (Alternative No. 1) would be 5.97 MGD, which would meet projected PDD through 2045. If the ASR is converted to a supply well (Alternative No. 2), firm finished water capacity would be 4.65 MGD, which would meet peak demands through year 2038.

A minimum firm raw water supply capacity of 3,637 gpm is needed for Phase 2. Assuming two Silurian wells are added through Phase 1A, and the ASR well remains in service (Alternative No. 1), as previously described, the available raw water firm capacity would be approximately 2,620 gpm. An additional 1,017 gpm of raw water supply is required for the Phase 2 expansion, which requires five additional Silurian wells for 3,620 gpm total firm capacity. The total well capacity would be approximately 4,720 gpm and would be sufficient for suppling raw water for normal operation of the WTP (4,017 gpm).

If the ASR well is converted to a raw water supply well (Alternative No. 2), then the firm capacity would be 3,320 gpm after Phase 1A. Two additional Silurian wells would be required at approximately 200 gpm each to increase the firm raw water supply capacity to 3,720 gpm in Phase 2. The total raw water supply capacity would be 4,820 gpm, which would be sufficient for supporting normal operation. This also assumes that IDNR will allow the required increase in the Water Use Permit from the Jordan aquifer for the increased demand.

Table 4.04-3 presents the total and firm raw water capacity for the Phase 2 improvements with Well No. 7 remaining in service as an ASR well (Alternative No. 1) or with Well No. 7 converted to a raw water supply well (Alternative No. 2). To meet projected demands, Alternative No. 1, Phase 2 should be completed by 2037 or Alternative No. 2, Phase 2 should be completed by 2028, when the ASR well is converted to a supply well.

	Capacity After Phase 2 Improvements	
	Alternative No. 1: Well No. 7 as an ASR Well*	**Alternative No. 2: ASR Well Conversion****
Firm Well Capacity (gpm)	3,620	3,720
Total Well Capacity (gpm)	4,720	4,820

*Phase 2 Alternative No. 1 includes five additional Silurian wells.
**Phase 2 Alternative No. 2 includes two additional Silurian wells.

Table 4.04-3 Raw Water Capacity Phase 2 Improvement Alternatives

D. Phase 3

To meet the projected 2045 demands, Phase 3 is only needed for Alternative No. 2, when the ASR well is converted to a supply well. Phase 3 includes adding one additional NF skid, which provides a total finished water capacity of 5.81 MGD without the ASR well. This would meet the projected PDDs through year 2045.

A minimum firm raw water supply capacity of 4,578 gpm is needed for Phase 3. If the ASR well is converted to a raw water supply well before Phase 3, the firm capacity would be 3,720 gpm from Phase 2. An additional 858 gpm of raw water supply is required for the Phase 3 expansion, which equates to five additional Silurian wells at 1,000 gpm total added capacity or 4,720 gpm total firm capacity. Total capacity would be 5,820 gpm, which is sufficient to supply water for normal operation.

Table 4.04-4 presents the total and firm raw water capacity for Phase 3 improvements required for Alternative No. 2 (Well No. 7 converted to a raw water supply well in Phase 1A). If Alternative No. 2 is selected, Phase 3 should be completed by 2038 to meet projected demands.

	After Phase 3 Improvement	
	Alternative No. 1: Well No. 7 as an ASR Well	Alternative No. 2: ASR Well Conversion*
Firm Well Capacity (gpm)	NA	4,720
Total Well Capacity (gpm)	NA	5,820

*Phase 3 Alternative No. 2 includes five additional Silurian wells.

Table 4.04-4 Raw Water Capacity Phase 3 Improvement Alternatives

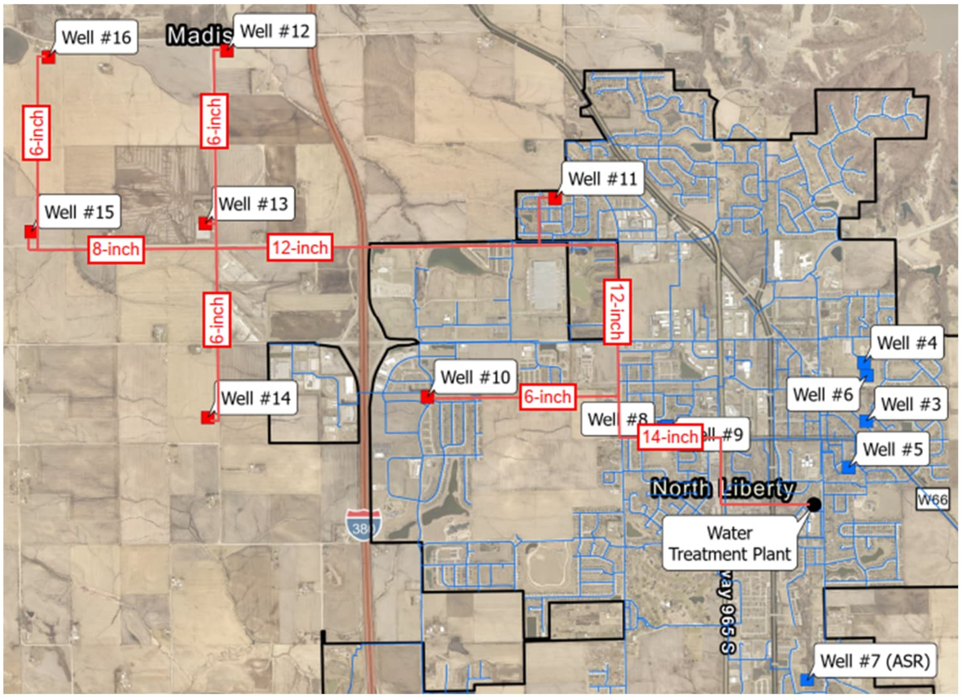
Figure 4.05-1 presents proposed well locations for Alternative Nos. 1 and 2 improvements through 2045, which are discussed in more detail in Section 4.05.

4.05 WELL LOCATIONS AND TESTING

Seven new Silurian wells will be needed through 2045 for either Alternative No. 1 or 2.

Proposed well locations are shown in Figure 4.04-1. The locations of proposed Well Nos. 10 through 14 were identified in the Alternative Source Water Evaluation completed by Strand (formerly FOX Engineering, Inc.) in 2017. Additional proposed Well Nos. 15 and 16 that were not previously evaluated in the 2017 study are shown to the west of the previously studied proposed wells. Additional groundwater modeling should be conducted at the appropriate time to evaluate potential yields and interference on normal operation of other wells. The proposed well locations were selected based on maximizing well spacing and minimizing interference with existing wells. Well locations are also located within close proximity to the existing or future City limits. Final well locations will need to be determined based on test drilling and evaluation of potential yields.

Figure 4.05-1 shows preliminary sizing for raw water main improvements needed to convey all source water to the WTP. Preliminary raw water main piping is sized to maintain minimum pipe velocities of 2 feet per second (fps), and maximum pipe velocities of 5 fps.



Map Source: Johnson County, Iowa, IDNR, Esri, TomTom, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, USEPA, NPS, USDA, USFWS

Figure 4.05-1 Preliminary Proposed Silurian Well Locations

4.06 OPINION OF PROBABLE COSTS (OPC)

Table 4.06-1 presents the opinion of cost for expanding the raw water supply for Alternative Nos. 1 and 2 in Phase 1A. The OPC for Alternative No. 1, Phase 1A improvements is $6,610,000. The OPC for Alternative No. 2, Phase 1A improvements is $1,010,000. Cost opinion values are presented in 2024 dollars.

Description	Alternative No. 1: Well No. 7 as an ASR Well	Alternative No. 2: Well No. 7 as Raw Water Supply
Raw Water Supply		
Silurian Wells	$1,398,000	$0
Well Control Buildings	$109,000	$0
Subtotal	**$1,507,000**	**$0**
Electrical and Controls (10%)	$151,000	$76,000
Sitework (15%)	$226,000	$0
Raw Water Main	$1,986,000	$515,000
Subtotal	**$3,870,000**	**$591,000**
General Requirements (15%)	$581,000	$89,000
Undefined Scope (20%)	$774,000	$118,000
Construction Subtotal	**$5,225,000**	**$798,000**
Contingencies (10%)	$523,000	$80,000
Construction Total	**$5,748,000**	**$878,000**
Engineering, Legal, and Administration (15%)	$862,000	$132,000
Total Project Cost	**$6,610,000**	**$1,010,000**

Table 4.06-1 Phase 1A Raw Water Supply OPC

Table 4.06-2 presents the OPC for expanding the raw water supply for Alternative Nos. 1 and 2 in Phase 2. The OPC for Alternative No. 1, Phase 2 improvements is $11,815,000. The OPC for Alternative No. 2, Phase 2 improvements is $6,610,000. Cost opinion values are presented in 2024 dollars.

Description	Alternative No. 1: Well No. 7 as an ASR Well	Alternative No. 2: Well No. 7 as Raw Water Supply
Raw Water Supply		
Silurian Wells	$3,493,000	$1,398,000
Well Control Buildings	$271,000	$109,000
Subtotal	**$3,764,000**	**$1,507,000**
Electrical and Controls (10%)	$376,000	$151,000
Sitework (15%)	$565,000	$226,000
Raw Water Main	$2,213,000	$1,986,000
Subtotal	**$6,918,000**	**$3,870,000**
General Requirements (15%)	$1,038,000	$581,000
Undefined Scope (20%)	$1,384,000	$774,000
Construction Subtotal	**$9,340,000**	**$5,225,000**
Contingencies (10%)	$934,000	$523,000
Construction Total	**$10,274,000**	**$5,748,000**
Engineering, Legal, and Administration (15%)	$1,541,000	$862,000
Total Project Cost	**$11,815,000**	**$6,610,000**

Table 4.06-2 Phase 2 Raw Water Supply OPC

Table 4.06-3 presents the OPC for expanding the raw water supply for Alternative No. 2 in Phase 3. The OPC for Alternative No. 2, Phase 3 improvements is $11,815,000. Cost opinion values are presented in 2024 dollars.

Description	Alternative No. 2: Well No. 7 as Raw Water Supply
Raw Water Supply	
Silurian Wells	$3,493,000
Well Control Buildings	$271,000
Subtotal	**$3,764,000**
Electrical and Controls (10%)	$376,000
Sitework (15%)	$565,000
Raw Water Main	$2,213,000
Subtotal	**$6,918,000**
General Requirements (15%)	$1,038,000
Undefined Scope (20%)	$1,384,000
Construction Subtotal	**$9,340,000**
Contingencies (10%)	$934,000
Construction Total	**$10,274,000**
Engineering, Legal, and Administration (15%)	$1,541,000
Total Project Cost	**$11,815,000**

Table 4.06-3 Phase 3 Raw Water Supply OPC

Project scheduling is discussed in Section 7 of this Facility Plan.

SECTION 5
WTP IMPROVEMENTS

5.01 OVERVIEW

Water treatment improvements presented in this Facility Plan are based on the *2013 Water System Facility Plan*, *2016 Facility Plan Amendment No. 1*, and resulting construction of the existing NF membrane WTP for hardness and contaminant removal. All treatment improvements discussed are for expanding the existing WTP to meet future demands. The projected timing for system demand to reach each treatment expansion phase is described in Section 3. Table 5.01-1 summarizes this information. WTP capacity for all phased expansions is determined based on operating 20 hours per day, 85 percent recovery from membrane treatment, and 20.5 percent bypass to achieve a total blended hardness of 100 mg/L. Phases 2 and 3 account for the additional 10 percent buildout of the existing membrane skids as described in Section 5.02. Firm capacity is based on either the ASR well out of service or one NF skid and one supply well out of service. Firm capacity plus the ASR well results in lower total finished water supply capacity than with the ASR well out of service.

Treatment Expansion Phase	Treatment Capacity Total (MGD)	Treatment Capacity Firm* (MGD)	Year Estimate without ASR Well	ASR Well Capacity (MGD)	Total Finished Water Supply Total (MGD)	Total Finished Water Supply Firm (MGD)	Year Estimate with ASR Well
Phase 1 (Existing)	3.17	2.96	2025	1.32	4.49	4.28	2036
Phase 1A	3.49	3.23	2027	1.32	4.81	4.52	2037
Phase 2	4.65	4.65	2038	1.32	5.97	5.97	2045
Phase 3**	5.81	5.81	2045	---	---	---	---

*Assumes one NF skid and one supply well out of service, 24-hour-per-day operation, and increased bypass up to maximum available raw water or maximum finished water total hardness of 155 mg/L.
**Phase 3 is only necessary to meet 2045 demands if the ASR well is converted to a supply well.

Table 5.01-1 Projected Timing of Demand Reaching WTP Capacity

5.02 PHASE 1A EXPANSION

The existing NF skids were supplied with capacity to expand the membranes by 10 percent. Each skid currently operates with a capacity of 700 gpm, so the additional 10 percent of buildout would increase capacity to 770 gpm. This will increase the treatment capacity of the NF plant from 3.17 to 3.49 MGD (in 20 hours of daily production). Buildout of the existing skids is considered Phase 1A for this Facility Plan. It is recommended that the buildout to the existing NF skids occur when all existing membranes are planned for replacement.

Komline-Harn, the City's membrane system supplier, completed a service visit in November 2023 during which the existing membranes were evaluated and found to be in good condition. Replacement of the existing membranes is not expected by Komline-Harn to be needed before 2027 to 2030. If the ASR well remains in service, Phase 1A expansion for replacing the existing membranes and adding the 10 percent additional capacity would likely occur as a standalone project between 2027 to 2030 since expansion of treatment to Phase 2 capacity would not need to be completed until 2037. If the ASR well is converted to a raw water supply well, then Phase 2 treatment expansion would need to occur sooner (by 2027) or when the ASR well is converted. Replacement and expansion of the existing membranes could be included with the Phase 2 expansion project if the ASR conversion occurs before the existing membranes need replaced.

5.03 PHASE 2 EXPANSION

Phase 2 expansion needs are as discussed in the following. Timing of Phase 2 expansion is dependent on whether the existing ASR well remains in service. With the ASR well in service, the total finished water supply from the existing WTP and ASR well has sufficient capacity to meet peak day demands through 2036. The anticipated replacement of the existing membranes and buildout of the existing skids by 10 percent would further delay the need for the Phase 2 expansion to 2037.

A. <u>NF System</u>

The Phase 2 WTP expansion includes the addition of a fourth membrane skid and accompanying equipment. This addition will increase the NF WTP's blended water treatment capacity to 4.65 MGD in a 20-hour-per-day operation with all NF skids having a capacity of 770 gpm (full buildout). Membrane treatment would continue to be based on 85 percent recovery of raw water through the membranes, and 20.5 percent bypass of raw water for a blended hardness of 100 mg/L.

As discussed in Section 4.03, the system firm capacity is provided by operating with one skid out of service for 24 hours per day and increasing the bypass flow. The resulting finished water hardness would be approximately 140 mg/L.

B. <u>Aeration</u>

The existing aerator has a rated capacity of 2,100 gpm (2.52 MGD in 20 hours) for treating permeate water. Permeate passes through the aerator before mixing with bypass water. For Phase 2, a minimum capacity of 3,080 gpm is needed to treat all NF permeate water. The aeration capacity will need to be expanded in Phase 2. There is space available for installation of a second, identical, forced-draft aerator on the WTP roof adjacent to the existing aerator. The addition of a second aerator will increase the permeate aeration capacity to 4,200 gpm (5.04 MGD in 20 hours), which is sufficient for Phases 2 and 3 as described in the following.

C. <u>Chemical Feed</u>

Table 5.03-1 presents existing bulk and day storage volumes and recommended storage volumes to provide adequate capacity through Phase 2. Storage requirements and recommendations are determined by the Ten State Recommended Standards for Water Works (Ten State Standards), 2012 Edition; 30 days of bulk chemical storage is required for each chemical. Additionally, it is recommended that day tanks should hold no more than 30 hours of supply. Day tanks were originally sized to provide adequate capacity through Phase 3. It should be noted that while the existing day tank sizing is appropriate, given the 2012 Edition of the Ten State Standards, which IDNR currently references, more recent versions of the Ten State Standards revise the language to be more specific. In the 2018 Edition and beyond, day tanks are recommended to hold no more than 30 hours of supply, assuming ADD. This could be a consideration for day tank sizing in the future if IDNR adopts a newer edition of the Ten State Standards.

Table 5.03-2 presents the existing firm chemical feed pumping capacity and the peak feed rate for Phase 2. If firm pumping capacity (one pump out of service) does not meet the Phase 2 peak feed rate, additional pumping capacity needs to be provided. Phase 2 chemical feed improvements to meet these storage and pumping needs are detailed below.

Chemical Name	Existing Bulk Storage (gallons)	Existing Day Storage (gallons)	Recommended Minimum Phase 2 Bulk Storage* (gallons)	Recommended Maximum Phase 2 Day Storage* (gallons)
Antiscalant (Vitec 3000)	460	30	430	20
Sodium Hypochlorite	6,100	155	2,790	155
Sodium Hydroxide, Caustic	7,800	540	8,810	660
Fluoride (Hydroflurosilic acid)	155	20	240	15
Phosphate (LPC-4)	460	30	420	25

*Recommended volume based on Ten State Standards, 2012 Edition

Table 5.03-1 Phase 2 Chemical Storage Capacity Requirements

Chemical Name	Existing Firm Pumping Capacity (gph)	Phase 2 Peak Feed Rate (gph)
Antiscalant (Vitec 3000)	1.5	0.72
Sodium Hypochlorite	11.8	6.20
Sodium Hydroxide, Caustic	23.0	26.44
Fluoride (Hydroflurosilic acid)	1.5	0.55
Phosphate (LPC-4)	1.5	0.93

Table 5.03-2 Phase 2 Chemical Pump Feed Requirements

1. Antiscalant

The existing bulk storage capacity for antiscalant is 460 gallons, which is provided by two 230-gallon bulk storage tanks. The existing storage volume is adequate to provide 30 days of storage through Phase 2.

The existing antiscalant day tank has a capacity of 30 gallons, which is adequate through Phase 2.

The existing firm pumping capacity in the antiscalant feed system is 1.5 gph. The peak feed rate for Phase 2 is 0.72 gph. The existing chemical feed pumps have sufficient capacity through Phase 2.

2. Sodium Hypochlorite, 12.5 Percent Solution

The existing bulk storage capacity for sodium hypochlorite is 6,100 gallons, which is provided by one 2,000- and one 4,100-gallon bulk storage tank. The existing bulk storage tanks provide sufficient capacity through Phase 2.

The existing sodium hypochlorite day tank has a capacity of 155 gallons, which is adequate through Phase 2.

The existing firm pumping capacity in the sodium hypochlorite feed system is 11.8 gph. The peak feed rate for Phase 2 is 6.20 gph. The existing chemical feed pumps have sufficient capacity through Phase 2.

3. Sodium Hydroxide, Caustic

The existing storage capacity for sodium hydroxide is 7,800 gallons, which is provided by two 3,900-gallon bulk storage tanks. The existing storage volume is not adequate to provide 8,810 gallons, which is 30 days of storage for Phase 2. There is space available in the caustic room for one additional 3,900-gallon tank. The addition of this tank will increase storage total capacity to 11,700 gallons, which will be necessary to meet 30-day storage requirements in accordance with the Ten State Standards in Phase 2.

The existing sodium hydroxide day tank has a capacity of 540 gallons, which is adequate through Phase 2.

The existing firm pumping capacity in the sodium hydroxide feed system is 23.0 gph. The peak feed rate for Phase 2 is 26.44 gph. Additional pumping capacity will be required for Phase 2. The interior tubing of each pump, which is currently 6.4-millimeter (mm) diameter can be increased to 8.0-mm diameter. This will increase the firm pumping capacity to 36.5 gph, which is sufficient through Phase 2.

4. Fluoride

The existing storage capacity for fluoride (hydrofluorsilicic acid) is 155 gallons. Additional storage is needed for Phase 2 to meet 30-day storage needs of 240 gallons. There is space available in the fluoride room for one additional 155-gallon tank. The addition of this tank will increase storage capacity to 310 gallons, which will be sufficient to meet 30-day storage requirements in accordance with the Ten State Standards in Phase 2.

The existing fluoride day tank has a capacity of 20 gallons, which is adequate through Phase 2.

The existing firm pumping capacity in the fluoride feed system is 1.5 gph. The peak feed rate for Phase 2 is 0.55 gph. The existing chemical feed pumps have sufficient capacity through Phase 2.

5. Phosphate

Phosphate storage and pumping capacity requirements were calculated using the current dose of 1.8 mg/L. Potential changes to the phosphate feed system to address concerns related to iron removal is discussed later in this section.

The existing storage capacity for phosphate is 460 gallons, which is provided by two 230-gallon bulk storage tanks. The existing storage is sufficient to provide 30 days of storage through Phase 2.

The existing phosphate day tank has a capacity of 30 gallons, which is adequate through Phase 2.

The firm pumping capacity in the phosphate feed system is 1.5 gph. The peak feed rate for Phase 2 is 0.84 gph. The existing chemical feed pumps have sufficient capacity through Phase 2.

D. High Service Pumps

As discussed in Section 3, the existing high service pumps have a firm capacity of 3,334 gpm (4.00 MGD in 20 hours of operation or 4.8 MGD in 24 hours of operation). The high service pumps need to at least provide a firm capacity of 4.65 MGD (Phase 2 WTP design capacity as shown in Table 5.01-1) in 24 hours of operation to allow pumping of all treated water produced to be pumped to the distribution system. The two of the three existing high service pumps would need to run nearly 24 hours per day to accomplish this.

There is space for a fourth pump to be added adjacent to the existing high service pumps. The addition of one more 150-hp pump with a design capacity of 1,667 gpm would increase the firm pumping capacity to 5,000 gpm (6.00 MGD with 20 hours of runtime, or 7.20 MGD with 24 hours of runtime). The addition of a pump would allow water to be pumped to the distribution system at the same rate of production. This additional pump will also meet the 2045 peak day demand of 5.81 MGD.

5.04 PHASE 3 EXPANSION

Phase 3 expansion needs are as discussed in the following. Timing of the Phase 3 expansion is dependent on whether the existing ASR well remains in service. With the ASR well in service, the total finished water supply from the WTP expanded for Phase 2 and the ASR well has sufficient capacity to meet peak day demands through 2045. If the ASR well is converted to a raw water supply well, then the Phase 3 expansion is projected to be needed by 2038 to meet demands through 2045 or near the 20-year design period.

Phase 3 is the ultimate buildout of the existing WTP. It is recommended that this Facility Plan be updated before Phase 3 improvements to reevaluate projections and to identify any advances in technology that would allow additional water treatment within the existing WTP footprint. Otherwise, expansion of the existing building would be required for additional capacity beyond Phase 3. Evaluation of treatment alternatives beyond the full buildout of the existing WTP is beyond the scope of this Facility Plan.

A. NF System

Phase 3 plant expansion is defined by the addition of a fifth membrane skid and accompanying equipment. This addition will increase the blended water treatment capacity from 4.65 MGD in Phase 2 to 5.81 MGD in 20 hours of operation (4,844 gpm) with all NF skids having a capacity of 770 gpm. Membrane treatment would continue to be based on 85 percent recovery of raw water through the membranes, 20 percent bypass of raw water (994 gpm bypassed), and a blended hardness of 100 mg/L.

Firm capacity of 5.81 MGD with one skid out of service could be achieved by operating 24 hours per day and increasing bypass water to achieve a finished water quality of 115 mg/L.

B. Aeration

For Phase 3, a minimum capacity of 3,850 gpm is needed to treat all NF permeate water. The second aerator added during Phase 2 provides 4,200 gpm (5.04 MGD in 20 hours) capacity, which is sufficient for Phase 3.

C. Chemical Feed

Table 5.04-1 presents bulk and day storage volumes after Phase 2 is completed and recommended storage volumes to provide adequate capacity through Phase 3. Table 5.04-2 presents firm chemical feed pumping capacity after Phase 2 is completed and the required peak feed rate through Phase 3. If firm pumping capacity (one pump out of service) does not meet the Phase 3 peak feed rate, additional pumping capacity needs to be provided. Phase 3 chemical feed improvements to meet these storage and pumping needs are detailed below.

Chemical Name	Bulk Storage after Phase 2 (gallons)	Day Storage after Phase 2 (gallons)	Recommended Minimum Phase 3 Bulk Storage* (gallons)	Recommended Maximum Phase 3 Day Storage* (gallons)
Antiscalant (Vitec 3000)	460	30	540	20
Sodium Hypochlorite	6,100	155	3,490	190
Sodium Hydroxide, Caustic	11,700	540	11,010	820
Fluoride (Hydroflurosilic acid)	310	20	300	20
Phosphate (LPC-4)	460	30	520	30

*Recommended volume based on Ten State Standards, 2012 Edition

Table 5.04-1 Phase 2 Chemical Storage Capacity Requirements

Chemical Name	Firm Pumping Capacity After Phase 2 (gph)	Phase 3 Peak Feed Rate (gph)
Antiscalant (Vitec 3000)	1.5	0.90
Sodium Hypochlorite	11.8	7.75
Sodium Hydroxide, Caustic	36.5	33.04
Fluoride (Hydroflurosilic acid)	1.5	0.69
Phosphate (LPC-4)	1.5	1.16

Table 5.04-2 Phase 2 Chemical Pump Feed Requirements

1. Antiscalant

The existing bulk storage capacity of 460 gallons is not sufficient to provide 30 days of supply of antiscalant through Phase 3. There is space available in the antiscalant room for one additional 230-gallon tank. The addition of this tank will increase storage capacity to 690 gallons, which will be necessary to meet 30-day storage requirements in accordance with the Ten State Standards in Phase 3.

The existing antiscalant day tank has a capacity of 30 gallons, which is adequate through Phase 3.

The existing firm pumping capacity in the antiscalant feed system is 1.5 gph. The peak feed rate of antiscalant for Phase 3 is 0.90 gph. The existing chemical feed pumps are satisfactory through Phase 3.

2. Sodium Hypochlorite, 12.5 Percent Solution

The existing bulk storage capacity for sodium hypochlorite of 6,100 gallons is sufficient to provide 30 days of supply through Phase 3.

The existing sodium hypochlorite day tank has a capacity of 155 gallons, which is adequate through Phase 3.

The existing firm pumping capacity in the sodium hypochlorite feed system is 11.8 gph. The peak feed rate for Phase 3 is 7.75 gph. The existing chemical feed pumps are satisfactory through Phase 3.

3. Sodium Hydroxide, Caustic

With the sodium hydroxide bulk storage added in Phase 2, 11,700 gallons with be available, which is sufficient to meet the 11,010 gallons needed to provide 30 days of supply through Phase 3.

The existing sodium hydroxide day tank has a capacity of 540 gallons, which is adequate through Phase 3.

After Phase 2 improvements, 36.5 gph of firm pumping capacity is provided in the sodium hydroxide feed system. This is sufficient to meet the Phase 3 peak feed rate of 33.04 gph.

4. Fluoride

With the fluoride bulk storage added in Phase 2, 310 gallons with be available which is sufficient to meet the 300 gallons needed to provide 30 days of supply through Phase 3.

The existing sodium hydroxide day tank has a capacity of 20 gallons, which is adequate through Phase 3.

The existing firm pumping capacity in the fluoride feed system is 1.5 gph. The peak feed rate for Phase 3 is 0.69 gph. The existing chemical feed pumps are satisfactory through Phase 3.

5. Phosphate

The existing bulk storage capacity of 460 gallons is not sufficient to provide 30 days of supply of phosphate at the current feed rate and dose through Phase 3. There is space available in the phosphate room for one additional 230-gallon tank. The addition of this tank will increase storage capacity to 690 gallons, which will be necessary to meet 30-day storage requirements in accordance with the Ten State Standards in Phase 3.

The existing sodium hydroxide day tank has a capacity of 30 gallons, which is adequate through Phase 3.

The existing firm pumping capacity in the phosphate feed system is 1.5 gph. The peak feed rate for Phase 3 is 1.16 gph. The existing chemical feed pumps are satisfactory through Phase 3.

C. High Service Pumps

The high service pump that would be added in Phase 2 will increase the firm pumping capacity to 5,000 gpm (6.0 MGD in 20 hours or 7.20 MGD with 24 hours of runtime). The peak day demand in the 20-year design year (2045) is 5.81 MGD, as discussed in Section 2. With the additional pumping capacity installed in Phase 2, high service pumping provides adequate firm capacity through the projected 2045 design year peak day demand. The firm pumping capacity will also allow all water produced in a 20-hour day by the WTP (5.81 MGD) to be pumped to the distribution system.

5.05 IRON REMOVAL IN BYPASS

The City has indicated that there have been incidents of discoloration at dead ends in the distribution system in areas with relatively older water, which is caused by excess oxidized iron. The City currently feeds a 50/50 polyphosphate and orthophosphate blend (LPC-4) as its phosphate feed before disinfection and after blending of the permeate from the NF skids and the bypass water. Generally, orthophosphate is used as a corrosion control measure, and polyphosphate is used to sequester iron and/or manganese. Polyphosphate/orthophosphate blends, like the one the City uses currently, are used to perform both functions simultaneously. When designing a phosphate feed system, a balance needs to be met wherein enough orthophosphate is present to perform adequate corrosion control and enough polyphosphate is fed to sequester the right amount of iron or manganese without overdosing the phosphate blend. Overdosing has the potential to waste money and add unnecessary chemical to the finished water supply.

Before changing the blend or dosage of the phosphate for iron sequestration, the first line of defense against discoloration in the distribution system is an appropriate hydrant flushing plan. Iron sequestering chemicals such as polyphosphate can eventually (after several days) “loosen their grip” on the iron they have sequestered. If water is old enough, the iron will no longer be sequestered. Low velocity flushing and flushing too infrequently can be a contributing factor to discoloration at the ends of a system. A unidirectional flushing plan may be necessary, and more frequent hydrant flushing may adequately manage the discoloration without changes to the chemical feed.

Multiple chemical suppliers were contacted for opinions on phosphate blend and dose, given the City's iron levels. Additionally, other methods for iron removal or sequestration were considered, but any other method requiring a different chemical would require a new treatment system.

Given the average iron concentrations reported by the City (see Table 3.02-2), the current phosphate blend and dose should be adequate to sequester the iron present. However, another consideration if it appears that iron is not being adequately sequestered is whether the iron has oxidized before the phosphate being introduced. Iron can only be reliably sequestered if the iron has not yet oxidized. If oxygen is introduced to the raw water at the well site or in the plant, iron oxidation is possible. The City has indicated that there are higher incidents of discoloration in the system when a high volume of Silurian water is bypassed. Each Silurian well could be tested to verify whether oxidation is occurring at the well site. Any cascading water in the well could cause any soluble iron to oxidize. Testing can also be performed to determine if and where iron is oxidizing between the well sites and the phosphate feed point.

Oxidation leading to inadequate iron sequestration could also be due to aeration. Permeate is aerated before blending with the bypass water. Aerated permeate may be introducing enough oxygen to the blended water to reduce potential sequestration of iron from the bypass water. If adequate flushing does not appear to sufficiently mitigate discoloration in the system, the phosphate feed point could be moved to the bypass line, upstream of where the bypass connects to the aerated permeate line. The phosphate should be fed directly to raw bypass water and not blended water. It should also be noted that iron sequestration should occur as far upstream of chlorination as possible, so iron is not oxidized by chorine.

Strand discussed iron sequestration at the City with Hawkins, Inc. (Hawkins), the City's chemical supplier. Hawkins recommended to do testing on the polyphosphate blend and dose. It is recommended that the City reach out to its phosphate supplier to determine an adequate testing plan. It is also recommended that the City review its hydrant flushing plan to determine whether improvements could be made to mitigate discoloration from old water at system ends. Additionally, the phosphate injection point should be moved to the bypass line upstream of the connection to the aerated permeate line.

5.06 OPC

Table 5.06-1 presents the OPC for Phase 1A, which includes replacing the membranes in the three existing membrane skids and buildout of those three skids to full capacity. The OPC for Phase 1A water treatment improvements is $1,270,000 in 2024 dollars.

Description	OPC
Water Treatment	
Membrane Buildout and Replacement	$850,000
Subtotal	**$850,000**
Electrical and Controls (18%)	$153,000
Construction Subtotal	**$1,003,000**
Contingencies (10%)	$101,000
Construction Total	**$1,104,000**
Engineering, Legal, and Administration (15%)	$166,000
Total Project Cost	**$1,270,000**

Table 5.06-1 Phase 1A Water Treatment OPC

Table 5.06-2 presents the opinion of cost for Phase 2, which includes one additional membrane skid, additional high service pumping and aeration capacity, and chemical feed improvements. The OPC for Phase 2 water treatment improvements is $3,457,000 in 2024 dollars.

Description	OPC
Water Treatment	
Aerator	$284,000
Chemical Storage Tanks	$29,000
Caustic Feed Pump Tubing	$1,000
Membrane Train	$1,100,000
High Service Pump	$194,000
Interior Piping	$46,000
Subtotal	**$1,654,000**
General Requirements (15%)	$249,000
Sitework (10%)	$166,000
Electrical and Controls (18%)	$298,000
Painting (2%)	$34,000
Undefined Scope (20%)	$331,000
Construction Subtotal	**$2,732,000**
Contingencies (10%)	$274,000
Construction Total	**$3,006,000**
Engineering, Legal, and Administration (15%)	$451,000
Total Project Cost	**$3,457,000**

Table 5.06-2 Phase 2 Water Treatment OPC

Table 5.06-3 presents the OPC for Phase 3, which includes one additional membrane skid, and chemical feed improvements. The OPC for Phase 3 water treatment improvements is $2,325,000 in 2024 dollars.

Description	OPC
Water Treatment	
Membrane Train	$1,100,000
Chemical Storage Tanks	$10,000
Interior Piping	$4,000
Subtotal	**$1,114,000**
General Requirements (15%)	$167,000
Sitework (10%)	$111,000
Electrical and Controls (18%)	$201,000
Painting (2%)	$22,000
Undefined Scope (20%)	$223,000
Construction Subtotal	**$1,838,000**
Contingencies (10%)	$184,000
Construction Total	**$2,022,000**
Engineering, Legal, and Administration (15%)	$303,000
Total Project Cost	**$2,325,000**

Table 5.06-3 Phase 3 Water Treatment OPC

Project scheduling is discussed in Section 7 of this report.

SECTION 6
WATER MODELING AND DISTRIBUTION SYSTEM IMPROVEMENTS

6.01 DISTRIBUTION MODEL UPDATES AND MODEL CALIBRATION

This water model was created using Openflows WaterGEMS® by Bentley Systems, Inc. The modeling described in this report was developed using the existing water model, which was created and originally calibrated in 2014, and geographic information system (GIS) shapefiles of the distribution system and water consumption data provided by the City.

A. Construction of Physical Elements

The GIS shapefiles provided by the City were imported into the modeling software to generate the up-to-date physical elements in the model (pipes, hydrants, tanks, and pumps). Pipe material and length were also imported from the GIS information. Hazen-Williams C-factors were automatically set to standard values based on pipe material and were adjusted as necessary during model calibration. Hydrants were imported as junctions. Tank elevations, heights, diameters, and volumes were imported and backchecked using data from the 2014 model. Pump curves provided by the City were input to define the existing high service and booster pumps.

B. Demand Distribution

Two types of demands were used to model the system. Demands were first set for large users manually, and then base unit demands were calculated and distributed to the remaining junctions.

The City provided 2023 annual consumption data of its top 20 largest users. Each top ten user's consumption was converted to gpm to determine an average water usage and placed on a diurnal demand pattern based on customer type. Large user consumption information is presented in Table 6.01-1, and diurnal water demands can be referenced in Appendix B.

Customer Name	Account No.	2023 Average Demand (gpm)	Pattern Type
Iowa City School District	19-00126-00	11.76	School
Cole's Quality Foods	01-05476-00	8.66	Commercial
Greenstate Credit Union	07-07004-00	7.87	Commercial
Frontier Natural Products Coop	01-04515-01	7.36	Commercial
Keystone Place	04-00001-00	5.78	Residential
Speedy Mikes Car Wash	01-03251-00	5.03	Commercial
Greenstate Credit Union	07-07004-00	3.36	Commercial
Centro Inc	01-03636-00	3.25	Commercial
North Liberty Living Center	09-01110-01	3.07	Residential
Heritage Christian School	10-04131-00	3.06	School
Tin Roost	01-08029-00	2.89	Commercial
Ishika Hospitality, Inc.	02-10501-03	2.68	Residential
Taco Bell	01-03253-00	2.35	Commercial
Field Day Brewery Company	01-03255-00	2.26	Commercial
Oasis Car Wash	07-00015-00	2.24	Commercial
Laundromania	06-01696-00	2.22	Commercial
Centro Inc	01-03637-00	1.92	Commercial
Iowa City School District	19-00128-01	1.76	School
Cole's Quality Foods	01-04089-04	1.55	Commercial
Quail Creek Homeowner Association	01-00981-00	1.47	Residential

Table 6.01-1 Large User Demand Summary

The total water demand, as presented in Section 2 of this Facility Plan was used to determine the average total water demand. To determine unit demands, the sum of the large user demands is subtracted from the total water demand and divided evenly among remaining junctions across the system.

For the existing system evaluation, the projected 2025 ADD and PDD were used (1.70 and 2.92 MGD, respectively, according to Table 2.04-1). Modeled 2045 ADD and PDD were 3.39 and 5.81 MGD, respectively, according to Table 2.04-1.

C. <u>Steady-State Calibration</u>

Hydrant flow tests were conduction by the City at 21 predetermined test locations across the system in spring 2024. The time, date, pressures, flow rates, and tank levels were recorded and provided to Strand for each completed hydrant test. To provide significant results and successful model calibration, it is recommended to obtain a pressure drop of at least 10 pounds per square inch (psi) at the monitoring residual hydrant during hydrant tests. Of the hydrant tests completed, two tests produced a pressure drop of less than 10 psi (Test Nos. 4 and 17). Those tests were not included in calibration for that reason.

Each flowing and monitoring hydrant was represented by a junction in the model. The flow rate was applied as a fixed demand at the appropriate flowing hydrant during residual conditions. Tank levels, pump operating status, time and date were input into the model individually for each test.

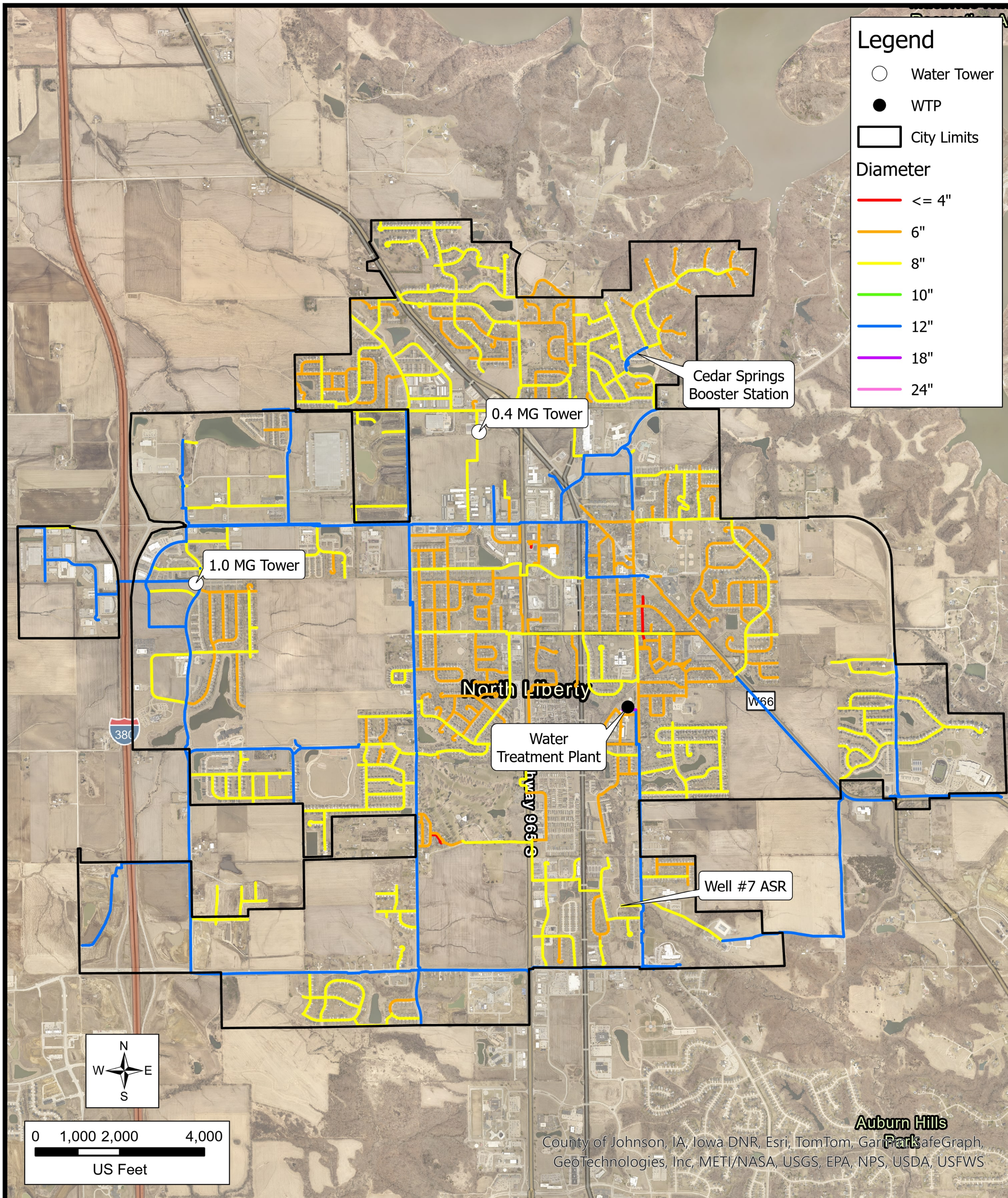
The model is considered adequately calibrated when the resulting pressure for both static and residual conditions at the monitoring hydrants are modeled within 5 psi of field results. Calibration is achieved by incrementally adjusting physical parameters of the model, primarily C-factors (pipe roughness). The results of the steady-state calibration are shown in Table 6.01-2.

Test No.	Field Values			Model Output		Difference	
	Flow (gpm)	Static (psi)	Residual (psi)	Static (psi)	Residual (psi)	Static (psi)	Residual (psi)
1	1,591	50	33	52.0	38.0	2.0	5.0
2	1,726	58	43	59.0	48.0	1.0	5.0
3	1,782	51	31	52.0	29.0	1.0	(2.0)
5	863	61	45	64.0	49.0	3.0	4.0
6	834	54	44	58.0	49.0	4.0	5.0
7	863	71	47	76.0	47.0	5.0	0.0
8	1,697	55	45	53.0	41.0	(2.0)	(4.0)
9	1,749	59	46	61.0	42.0	2.0	(4.0)
10	1,697	57	43	58.0	45.0	1.0	2.0
11	945	65	52	64.0	54.0	(1.0)	2.0
12	863	53	43	54.0	46.0	1.0	3.0
13	1,916	65	50	64.0	47.0	(1.0)	(3.0)
14	2,033	69	57	69.0	52.0	0.0	(5.0)
15	4,111	66	56	64.0	51.0	(2.0)	(5.0)
16	996	56	41	57.0	36.0	1.0	(5.0)
18	1,591	55	32	57.0	34.0	2.0	2.0
19	996	62	51	63.0	48.0	1.0	(3.0)
20	1,068	61	50	61.0	49.0	0.0	(1.0)
21	1,667	58	44	61.0	42.0	3.0	(2.0)

Table 6.01-2 Steady-Calibration Results Summary

6.02 EXISTING SYSTEM ANALYSIS

An analysis of the current distribution system was conducted to evaluate potential existing system deficiencies. For this evaluation, projected 2025 ADD and PDD established in Section 2 of this report were used. All scenarios were run with tanks at an initial hydraulic grade line of 913 feet for an effective volume of approximately 85 percent. Figure 6.02-1 presents a summary of major existing distribution system components. Note that the ASR well was assumed to not be pumping into the distribution system for each scenario. The 2025 ADD scenarios included one high service pump running, and 2025 PDD scenarios included two high service pumps running.



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EXISTING DISTRIBUTION SYSTEM

WATER SYSTEM FACILITY PLAN
CITY OF NORTH LIBERTY
JOHNSON COUNTY, IOWA

STRAND ASSOCIATES®

FIGURE 6.02-1
7037.013

A. Operating Pressure

System operating pressures for a current ADD were modeled between approximately 42 and 85 psi. Figure 6.02-2 presents pressures across the system for an ADD in 2025.

System operating pressures for a current PDD were modeled between approximately 42 and 98 psi. Figure 6.02-3 presents pressures across the system for a PDD in 2025.

The Ten States Standards requires operating pressures during non-emergency conditions be between 35 and 100 psi, with ideal operating pressures between 60 and 80 psi. System low pressures are shown in both 2025 ADD and PDD scenarios on East Tartan Drive due to high ground elevations, but they were not shown to fall below the required minimum pressure. System high pressures were shown to be up to 98 psi at and around Rachael Street. This is due to relatively lower elevations and proximity to the WTP. Field verification of service pressures is recommended to verify whether service pressures in this area exceed 100 psi. Pressure reducing valves (PRV) should be considered at service connections affected by pressures exceeding 100 psi, contingent on field verification.

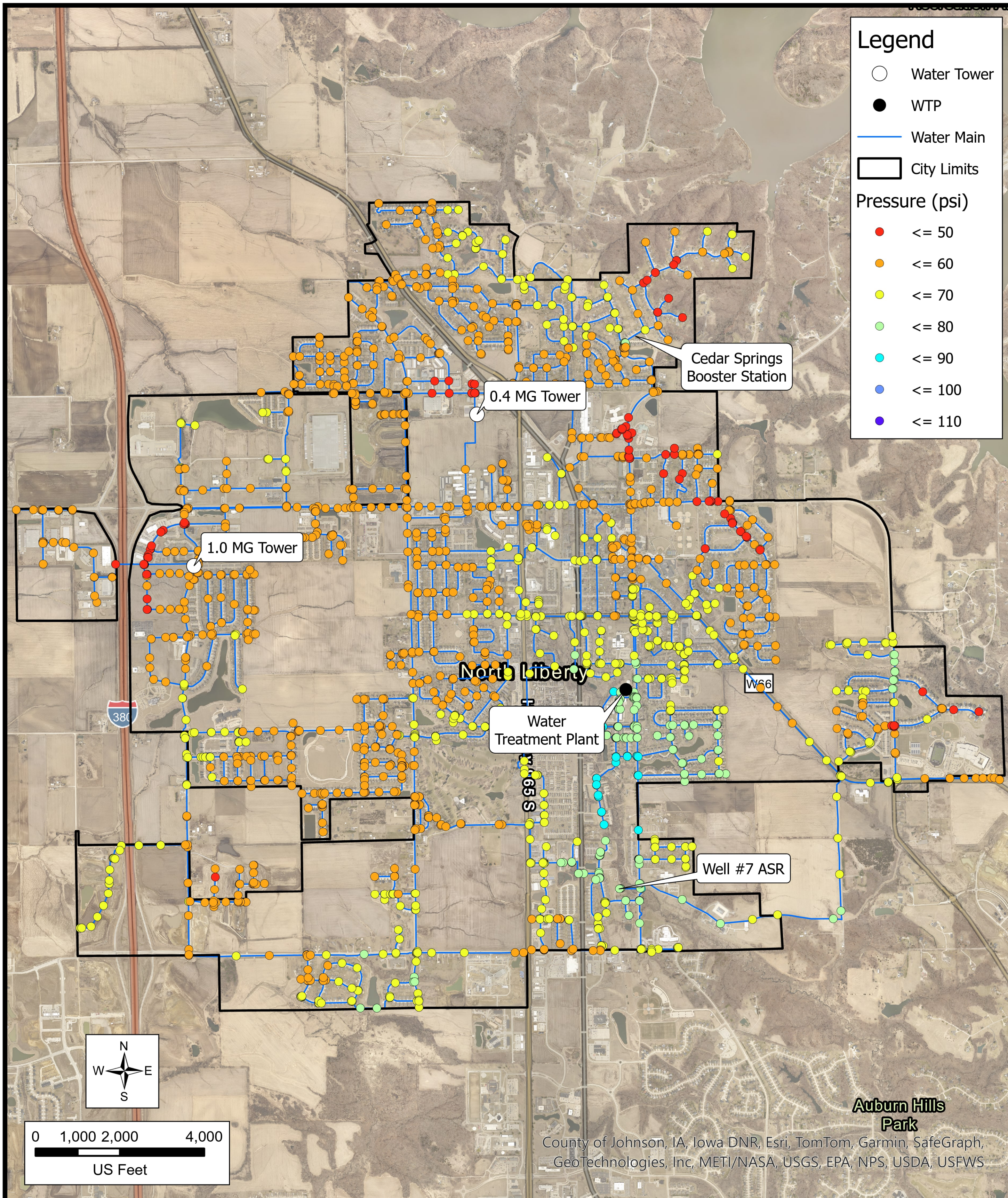
B. Fire Flow Availability

Federal and state laws do not require sizing the water distribution system components for fire protection. Providing a water distribution system that is capable of delivering adequate volumes of water for fire protection is a local decision to reduce the risk for loss of life and property. Insurance providers determine the flow and volume necessary to minimize damages based on occupancy, building materials, area, volume, and separation of individual structures.

With the augmentation of potable water distribution systems to provide fire protection, several methods have been developed to compute available fire flows. Generally, the Insurance Services Office (ISO) of Iowa and the America Water Works Association (AWWA) recommend the range of fire flows for the listed general building classifications shown in Table 6.02-1 while maintaining at least 20 psi in the distribution system. The modeled flow rate is not the same as the full capacity of water available from a given hydrant. The water distribution model is not modeling the flows and head loss associated with an individual hydrant and does not necessarily assume that a hydrant is fully open.

Zoning	Recommended Fire Flow Availability (gpm)
Residential	500 to 1,000
Commercial	1,500 to 2,500
Industrial/Institutional	3,000 to 12,000

Table 6.02-1 ISO and AWWA Recommended Fire Flow Availability



CURRENT AVERAGE DAY PRESSURES

WATER SYSTEM FACILITY PLAN
CITY OF NORTH LIBERTY
JOHNSON COUNTY, IOWA

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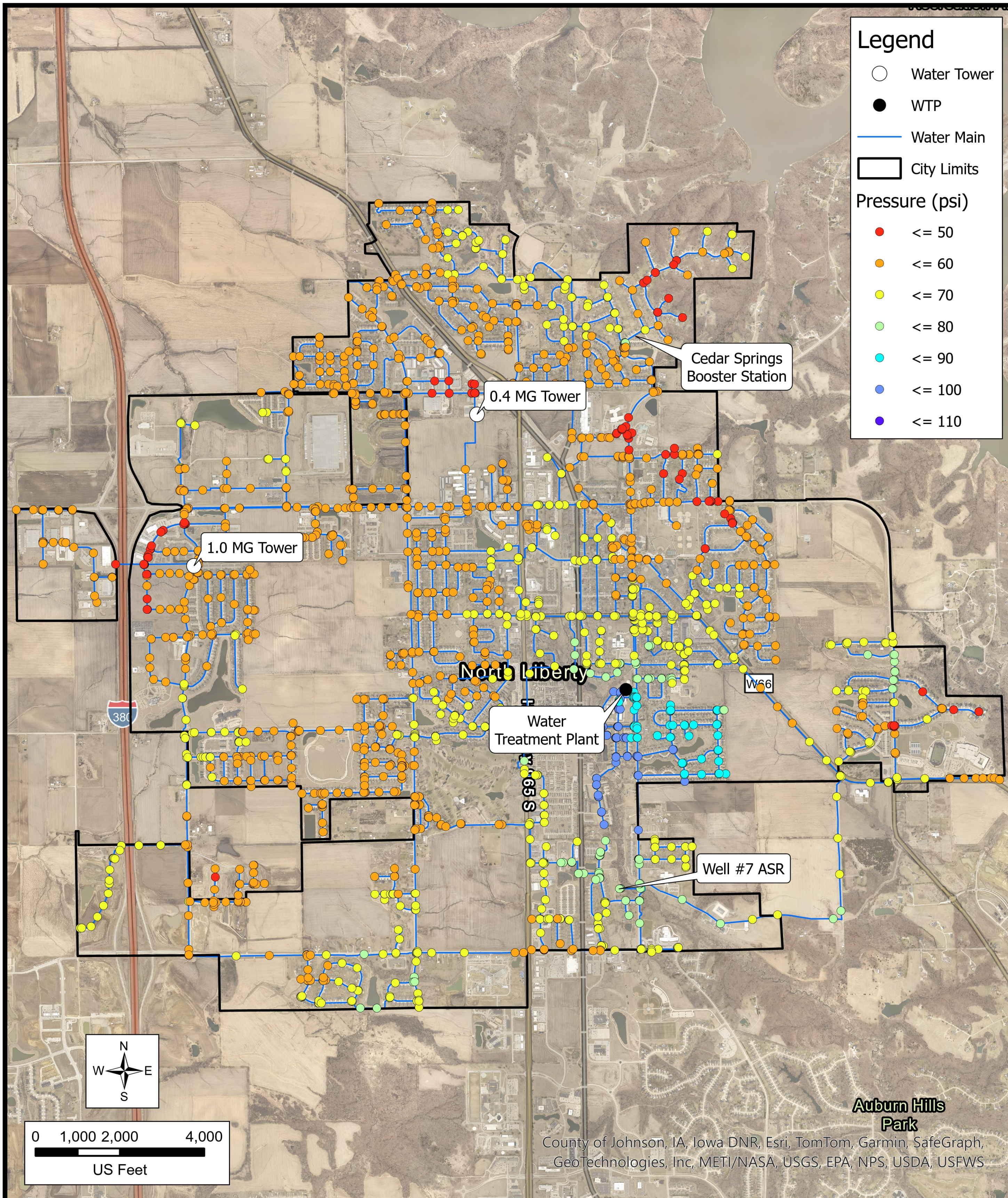
FIGURE 6.02-2
7037.013



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CURRENT PEAK DAY PRESSURES

WATER SYSTEM FACILITY PLAN
CITY OF NORTH LIBERTY
JOHNSON COUNTY, IOWA

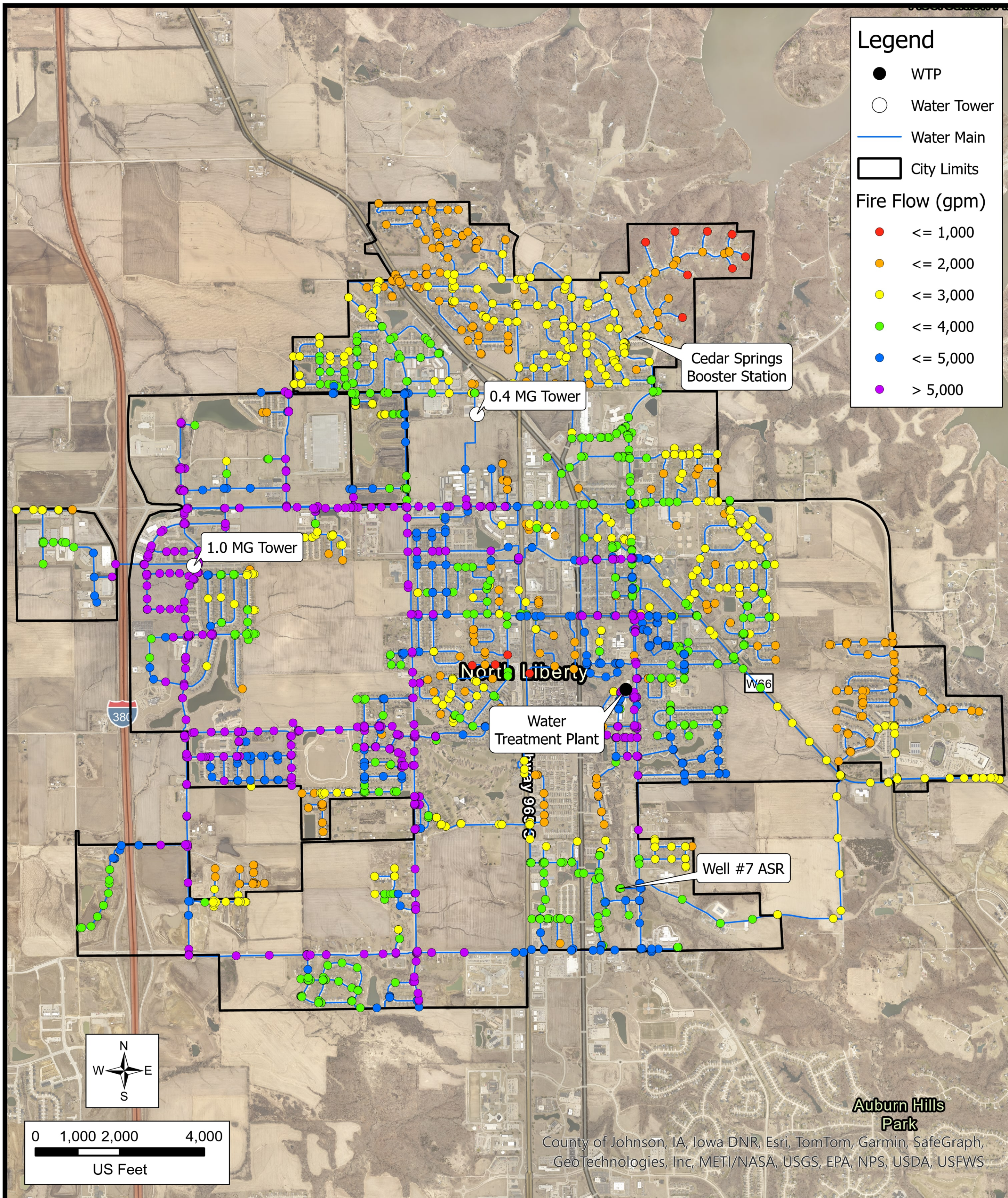
STRAND ASSOCIATES®

FIGURE 6.02-3
7037.013

Fire flow availability during PDD conditions while maintaining a minimum system pressure of 20 psi was modeled. Figure 6.02-4 presents the fire flow availability across the existing distribution system for a 2025 PDD. Modeled fire flow availability across the system while maintaining a minimum system pressure of 20 psi ranged between 700 to more than 10,000 gpm. Table 6.02-2 presents the modeled fire flow availability at the top ten large users' locations while maintaining a minimum system pressure of 20 psi during a 2025 PDD. Several points are shown in the model to not meet the minimum recommended available fire flow value during this scenario, most notably the property containing Liberty High School. Additional analysis by the ISO is needed to determine the exact ISO-required fire flow for the property; however, water main deficiencies and improvements (which are shown in the model to increase the available fire flow at Liberty High School) to the recommended range are discussed in Section 6.04.

Customer Name	Account No.	Modeled Available Fire Flow (gpm)	Zoning	Recommended Fire Flow (gpm)
Iowa City School District	19-00126-00	2,300	Institutional	3,000 to 12,000
Cole's Quality Foods	01-05476-00	3,200	Commercial	1,500 to 2,500
Greenstate Credit Union	07-07004-00	4,500	Commercial	1,500 to 2,500
Frontier Natural Products Coop	01-04515-01	4,100	Commercial	1,500 to 2,500
Keystone Place	04-00001-00	5,800	Residential	500 to 1,000
Speedy Mikes Car Wash	01-03251-00	4,200	Commercial	1,500 to 2,500
Greenstate Credit Union	07-07004-00	4,500	Commercial	1,500 to 2,500
Centro, Inc.	01-03636-00	2,800	Commercial	1,500 to 2,500
North Liberty Living Center	09-01110-01	3,800	Institutional	3,000 to 12,000
Heritage Christian School	10-04131-00	2,500	Institutional	3,000 to 12,000
Tin Roost	01-08029-00	6,100	Commercial	1,500 to 2,500
Ishika Hospitality, Inc.	02-10501-03	7,200	Residential	500 to 1,000
Taco Bell	01-03253-00	4,000	Commercial	1,500 to 2,500
Field Day Brewery Company	01-03255-00	4,600	Commercial	1,500 to 2,500
Oasis Car Wash	07-00015-00	3,000	Commercial	1,500 to 2,500
Laundromania	06-01696-00	3,600	Commercial	1,500 to 2,500
Centro, Inc.	01-03637-00	2,800	Commercial	1,500 to 2,500
Iowa City School District	19-00128-01	2,300	Institutional	3,000 to 12,000
Cole's Quality Foods	01-04089-04	3,200	Commercial	1,500 to 2,500
Quail Creek Homeowner Association	01-00981-00	2,500	Residential	500 to 1,000

Table 6.02-2 Modeled Available Fire Flow on a 2025 PDD



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CURRENT FIRE FLOW AVAILABILITY CONTOURS

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JOHNSON COUNTY, IOWA

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FIGURE 6.02-4
7037.013

C. Water Main Criticality

A criticality assessment was performed in the model for each existing segment of water main in the 2025 PDD scenario to determine which pipes have the greatest effect on the City's overall ability to supply customers. Pipe criticality is reported as the percentage of total system demand that cannot be delivered if a given pipe segment is out of service. This analysis provides a quantitative way of modeling the effect of removing water mains from the system based on a percentage of total system demands. Pipe criticality analysis does not include any assessment of importance of interrupting service to specific users. Pipes or pipe segments with higher criticality values indicate that a relatively higher percentage of total system demand would be isolated from either supply or storage in the event of a water main failure. High criticality values indicate areas that are not well looped or are not hydraulically connected to sources of water supply or storage within the system.

Figure 6.02-5 presents the model-predicted criticality analysis for the existing distribution system with 2025 PDDs. Areas where improvements are recommended based on criticality results are discussed in the following.

1. Harlen Street

The area east of Harlen Street will be isolated from the distribution system if the water main on Harlen Street were to be out of service. Looping can be achieved when water service is extended to areas to the north toward South Alexander Way, to the east toward Chipman Lane, or to the south toward Forevergreen Road, or some combination thereof. This improvement is critical due to the anticipated development in this area between Kansas Avenue and South Jones Boulevard.

2. Dubuque Street and North Liberty Road

The area around and directly north of Liberty High School would be isolated from service if the Dubuque Street water main were to be out of service. Looping the area could be accomplished by the addition of two water main extensions. Firstly, a 12-inch water main following North Liberty Road north to connect the dead end on North Liberty Road directly north of the high school to the intersection of East Penn Street and North Juniper Street would loop this area back into the rest of the distribution system.

Secondly, an 8-inch water main looping the dead end on the east side of the high school on Dubuque Street north to East Tartan Drive would allow service to be maintained to the high school if a segment of the Dubuque Street water main were to be out of service.

3. Industrial Zone West of Interstate (I-) 380

The industrial zone west of I-380 and south of West Penn Street is dependent on supply from a single 12-inch water main crossing the interstate. Looping can be achieved by the addition of a water main loop to the south and an additional I-380 crossing. To feed future development, a 12-inch water main running south through Jasper Street, and then tying in before the existing southern interstate crossing is recommended.

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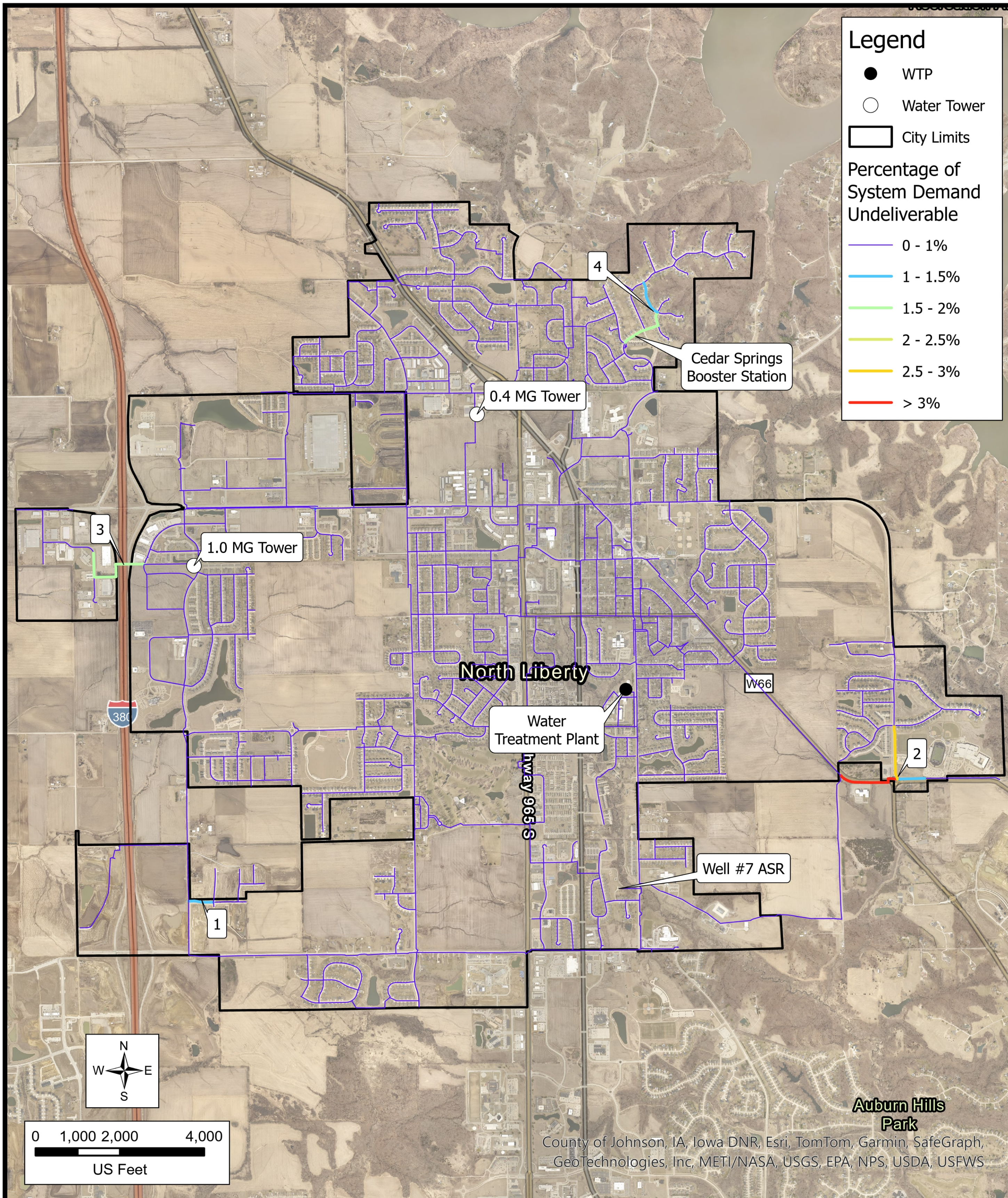

2025 WATER MAIN CRITICALITY

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FIGURE 6.02-5
7037.013

4. Cedar Springs Booster Station

The neighborhood fed by the Cedar Springs Booster Station is served by a single 12-inch water main and does not loop back into the rest of the system. Additional development is not anticipated in this area. As development and water demands grow in other areas of the City, this 12-inch water main at Cedar Springs Drive becomes less critical, which is shown in Figure 6.05-5. No water main improvements are recommended at this location at this time, but should be considered if development downstream of the booster station is planned.

6.03 WATER MAIN IMPROVEMENTS

Figure 6.03-1 presents proposed water main improvements, including minimum improvements recommended to satisfy modeled deficiencies, as shown in Section 6.02, and planned water main additions and looping.

1. Water main loop connecting Harlen Street to Forevergreen Road to improve hydraulic connectivity and mitigate service disruptions (approximately 1,800 feet of 12-inch water main). This improvement will serve future development between Kansas Avenue and South Jones Boulevard.

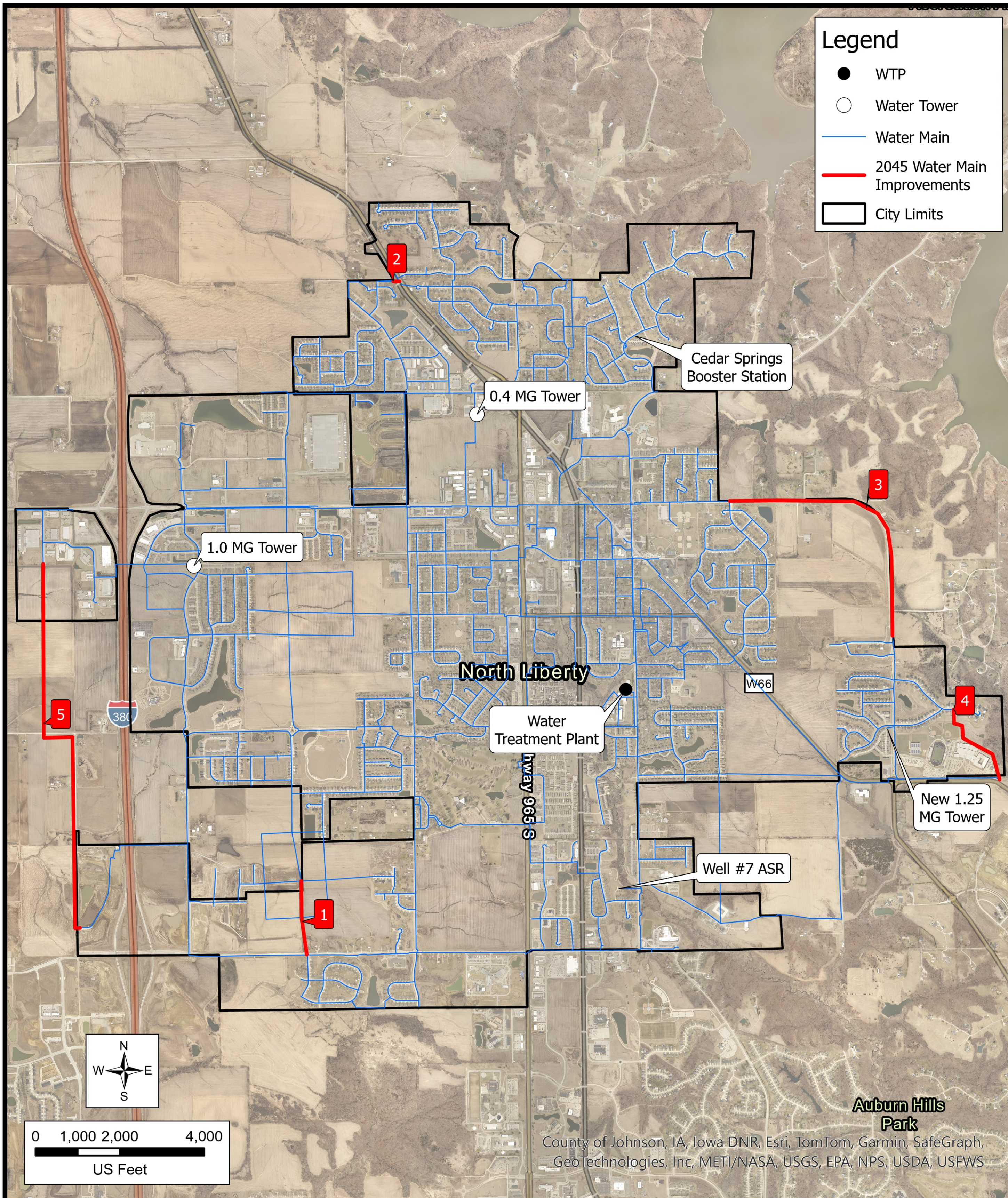
2. Connect 8-inch water mains on 230th Street to Pheasant Lane to provide redundancy to the northern neighborhoods (approximately 200 feet of 8-inch water main crossing County Road W60). The need for this improvement has been indicated by the City and is included in the City's current capital improvements plan.

3. Water main loop on northeast corner of North Liberty Road to mitigate service disruptions and increase available fire flow, particularly at Liberty High School (approximately 6,500 feet of 12-inch water main). This improvement is recommended to occur before building the additional water tower described in Section 6.04.

4. Water main loop connecting the southeast end of the Dubuque Street water main to East Tartan Drive to mitigate service disruptions to Liberty High School and provide additional redundant connectivity for the new water tower described in Section 6.04 (approximately 2,300 feet of 8-inch water main).

5. Water main loop on Jasper Avenue (approximately 9,500 feet of 12-inch water main). This improvement will provide redundancy, mitigate service disruptions, and feed growth to the industrial zone west of I-380.

In addition to water main improvements recommended to improve the existing distribution system conditions, additional water mains will need to be added before 2045 to serve undeveloped areas within the existing City limits. For purposes of this evaluation, the framework of water main in the areas projected to have development occur by 2045 was added to the model. These water main additions are also shown in Figure 6.03-1.



RECOMMENDED WATER MAIN IMPROVEMENTS

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FIGURE 6.03-1
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6.04 WATER STORAGE IMPROVEMENTS

Ten States Standards, Section 7.01 require that minimum water storage be provided to meet to the ADD. The total storage capacity in the system currently is 2.15 MG, which will remain sufficient until the City reaches a population of approximately 29,900 in 2031, in accordance with the demand projections presented in Section 2. After 2031 additional storage will need to be constructed to meet the ADD.

A 0.75-MG EST was planned to be constructed during Phase 2 in previously completed facility plans; however, to provide sufficient storage capacity for the ADD through the design year 2045, 3.4 MG of total finished water storage, or 1.25 MG of additional storage, is needed. A 1.25-MG water tower is recommended to meet future storage requirements. The water modeling discussed in Section 6.05 includes this future water tower at the "High School Tower Location #1" according to the results of the analysis summarized in the June 20, 2014, memorandum from FOX Engineering (now Strand) to the City (see Appendix C). Additional analyses are recommended before the construction of the tower to verify the preferred location depending on hydraulic modeling and land availability.

6.05 2045 SYSTEM ANALYSIS WITH RECOMMENDED IMPROVEMENTS

For the system analysis of the 2045 design year, water mains representing a potential backbone in areas within the City limits where development is most likely in the next 20 years were added. These water mains do not represent a full buildout of the water system but are shown as an example of what level of service could be provided through connections with the existing distribution system. The pipe diameters chosen for the growth areas include a mix of 12- and 8-inch water mains. Distribution system improvements described in Sections 6.03 and 6.04 were included in 2045 modeling scenarios. The 2045 modeling scenario includes the recommended 1.25-MG water tower located at "High School Location #1" just north of Liberty High School according to the June 20, 2014, memorandum. Figure 6.05-1 presents the 2045 system as modeled including improvements. All water mains added that are not currently existing were represented by doubled line-weight in the figure.

All scenarios were run with tanks at an initial hydraulic grade line of 913 feet (approximately 85 percent effective storage volume). The 2045 ADD scenarios include two high service pumps running and peak day scenarios included three high service pumps running. Note that the ASR well was assumed to not be pumping into the distribution system for each scenario.

The 2045 modeling scenario includes the addition of the UI Health Care North Liberty Campus, which is expected to open in summer 2025 on the corner of Highway 965 South and West Forevergreen Road. Water demand at the new health care center is modeled at an average rate of 83 gpm (120,000 gpd).

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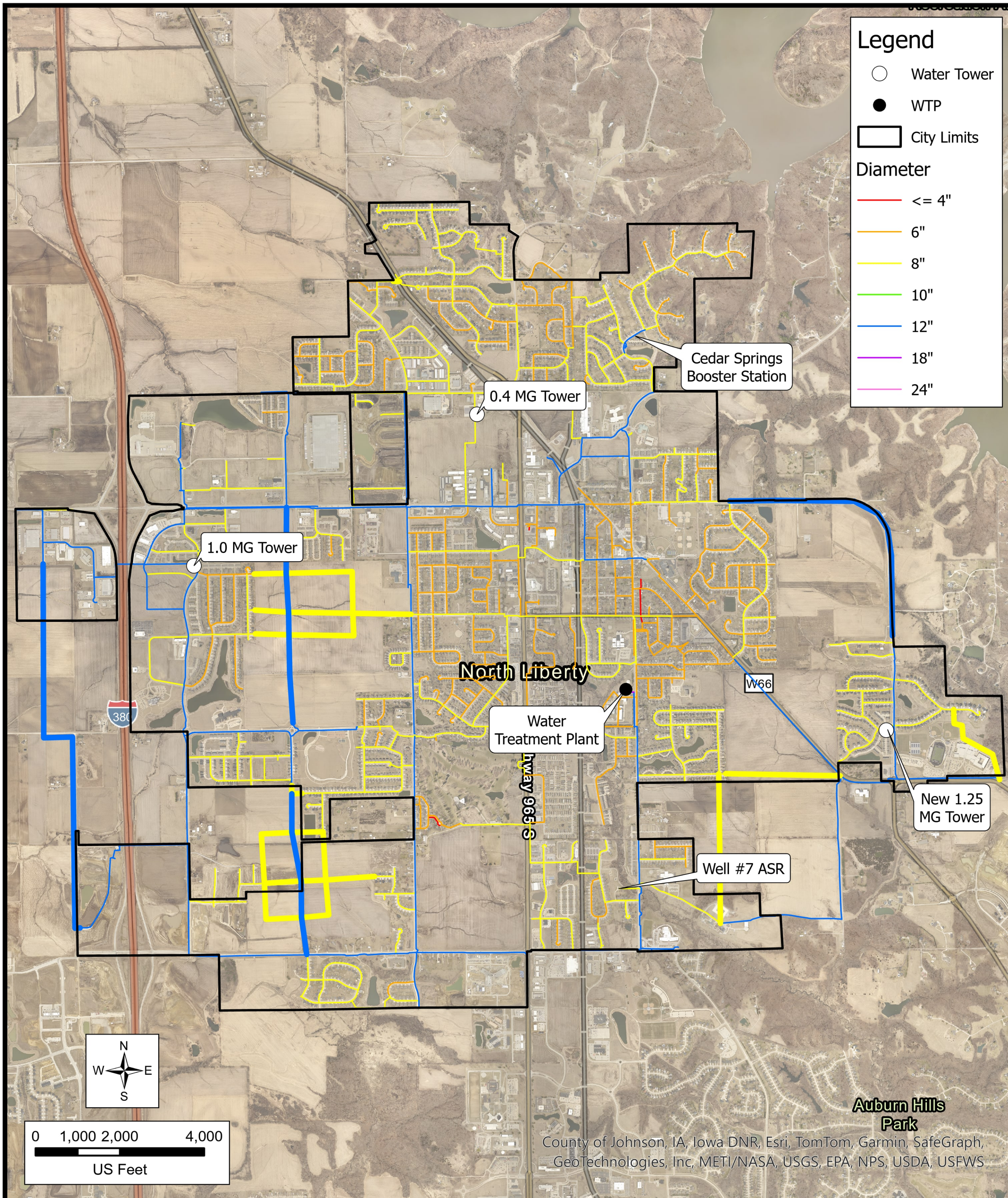

2045 DISTRIBUTION SYSTEM WITH IMPROVEMENTS

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FIGURE 6.05-1
7037.013

A. Operating Pressure

System operating pressures for the 2045 ADD scenario were modeled between approximately 42 and 86 psi across the system. Figure 6.05-2 presents pressures across the system for a projected ADD in 2045.

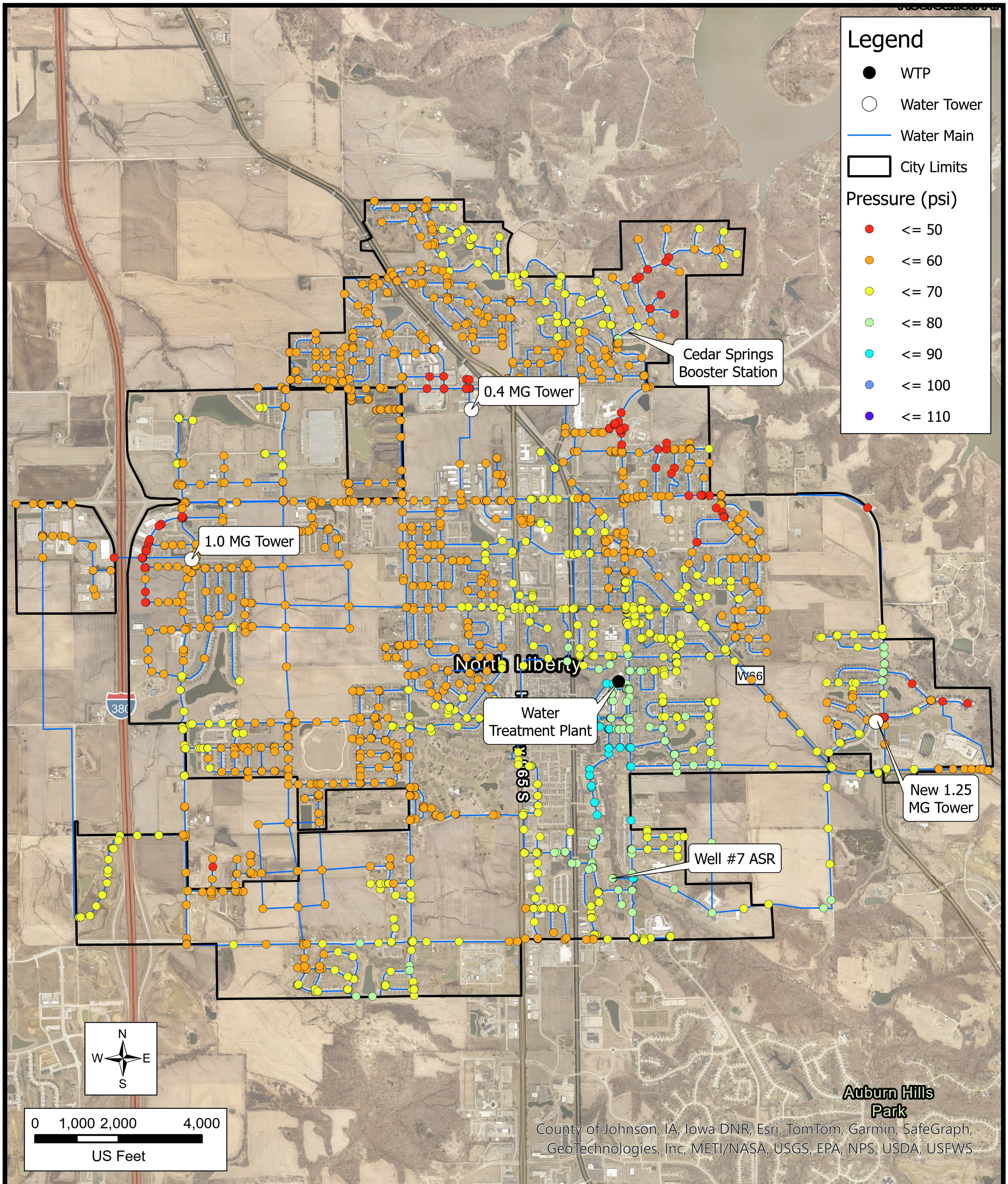
System operating pressures for a 2045 PDD were modeled between approximately 42 and 104 psi. Figure 6.05-3 presents pressures across the system for a projected PDD in 2045.

In 2045 demand scenarios, the lowest pressures were observed on East Tartan Drive due to high elevations of this area, but they were not shown to fall below 35 psi during ADD or PDD scenarios.

As in the existing system analysis, system high pressures were shown to be up to 104 psi at and around Rachael Street. This is due to relatively lower elevations and proximity to the WTP. Field verification is recommended to verify whether service pressures in this area exceed 100 psi. PRVs should be considered at service connections affected by pressures exceeding 100 psi, contingent on field verification.

B. Fire Flow Availability

Figure 6.05-4 presents the fire flow availability during the 2045 PDD scenario. Modeled fire flows across the system while maintaining a minimum system pressure of 20 psi ranged from 675 to 5,100 gpm. Fire flow availability is generally recommended within the ranges presented in Table 6.02-1. Table 6.05-1 presents the modeled fire flow availability at the top 20 large users' locations while maintaining a minimum system pressure of 20 psi during a 2045 PDD. All modeled available fire flows for these users maintained or improved compared to the 2025 PDD fire flow evaluation and are greater than the minimum recommended fire flow as shown in Table 6.05-1.



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2045 AVERAGE DAY PRESSURES

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FIGURE 6.05-2
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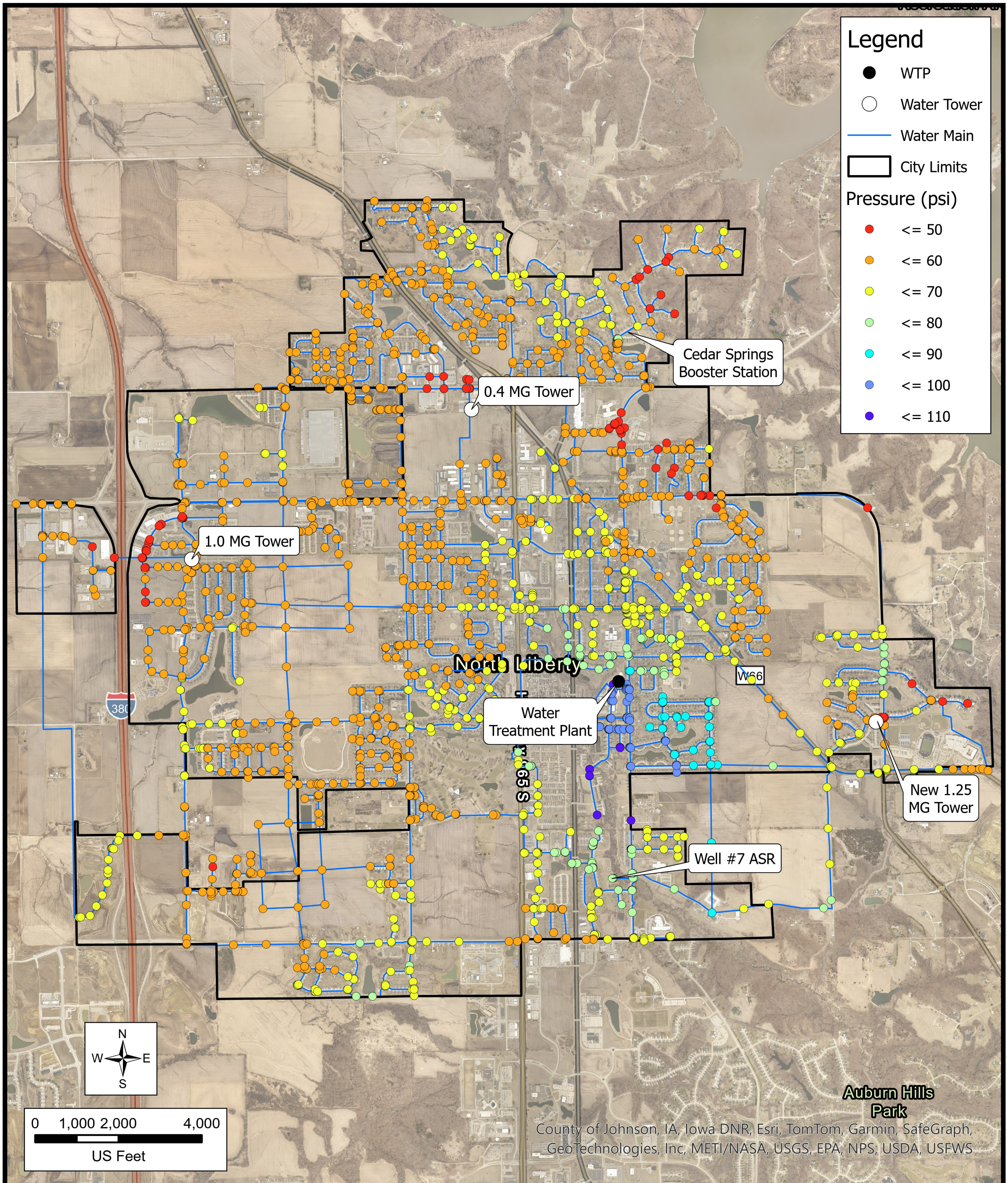

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2045 PEAK DAY PRESSURES

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FIGURE 6.05-3
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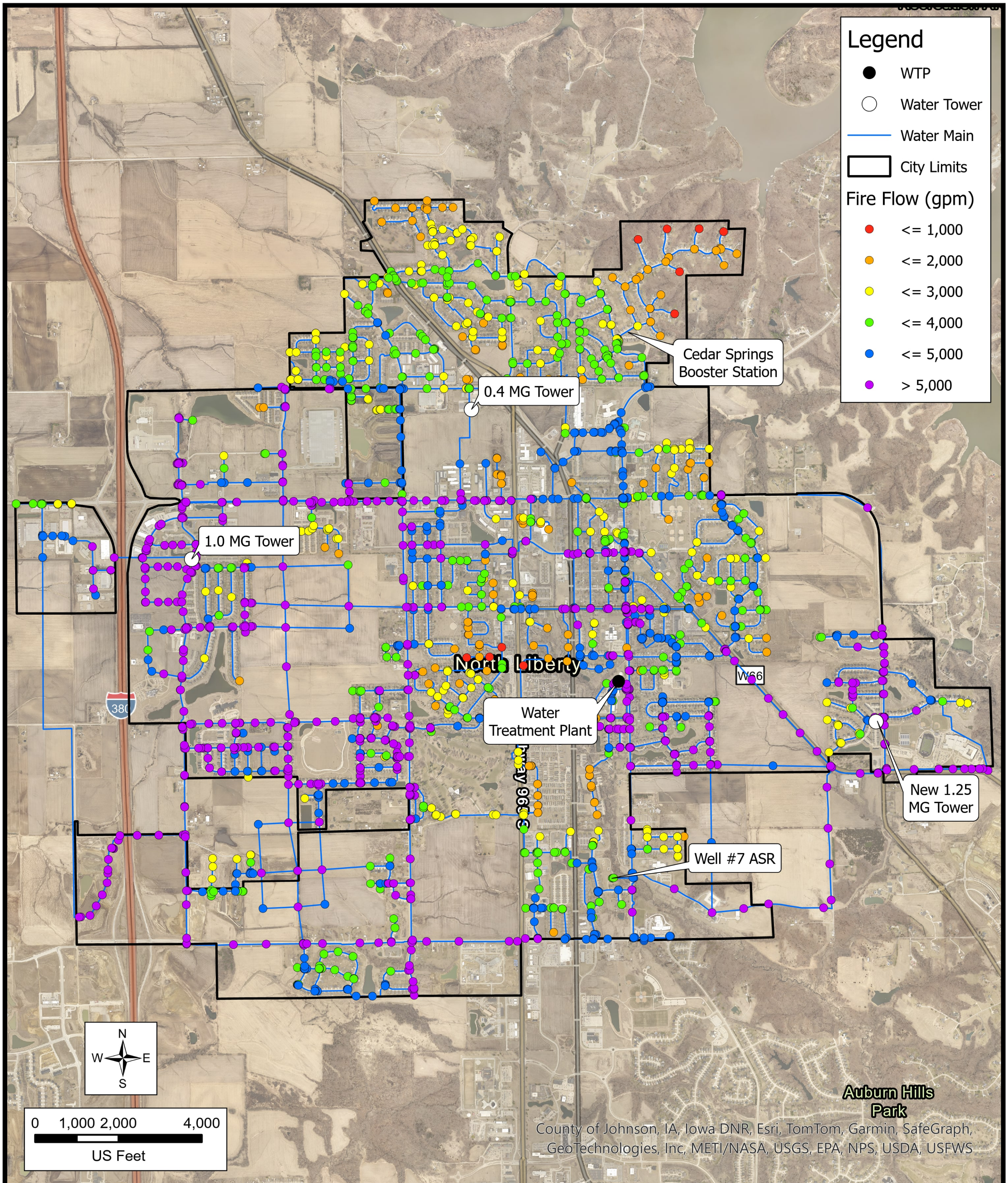

2045 FIRE FLOW AVAILABILITY CONTOURS

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FIGURE 6.05-4
7037.013

Customer Name	Account No.	Modeled Available Fire Flow (gpm)	Zoning	Recommended Fire Flow (gpm)
Iowa City School District	19-00126-00	8,400	Institutional	3,000 to 12,000
Cole's Quality Foods	01-05476-00	3,400	Commercial	1,500 to 2,500
Greenstate Credit Union	07-07004-00	4,300	Commercial	1,500 to 2,500
Frontier Natural Products Coop	01-04515-01	5,300	Commercial	1,500 to 2,500
Keystone Place	04-00001-00	7,700	Residential	500 to 1,000
Speedy Mikes Car Wash	01-03251-00	4,200	Commercial	1,500 to 2,500
Greenstate Credit Union	07-07004-00	4,300	Commercial	1,500 to 2,500
Centro, Inc.	01-03636-00	2,900	Commercial	1,500 to 2,500
North Liberty Living Center	09-01110-01	3,900	Institutional	3,000 to 12,000
Heritage Christian School	10-04131-00	3,200	Institutional	3,000 to 12,000
Tin Roost	01-08029-00	6,300	Commercial	1,500 to 2,500
Ishika Hospitality, Inc.	02-10501-03	10,000	Residential	500 to 1,000
Taco Bell	01-03253-00	4,000	Commercial	1,500 to 2,500
Field Day Brewery Company	01-03255-00	4,500	Commercial	1,500 to 2,500
Oasis Car Wash	07-00015-00	3,100	Commercial	1,500 to 2,500
Laundromania	06-01696-00	3,500	Commercial	1,500 to 2,500
Centro, Inc.	01-03637-00	2,900	Commercial	1,500 to 2,500
Iowa City School District	19-00128-01	6,200	Institutional	3,000 to 12,000
Cole's Quality Foods	01-04089-04	3,400	Commercial	1,500 to 2,500
Quail Creek Homeowner Association	01-00981-00	2,500	Residential	500 to 1,000

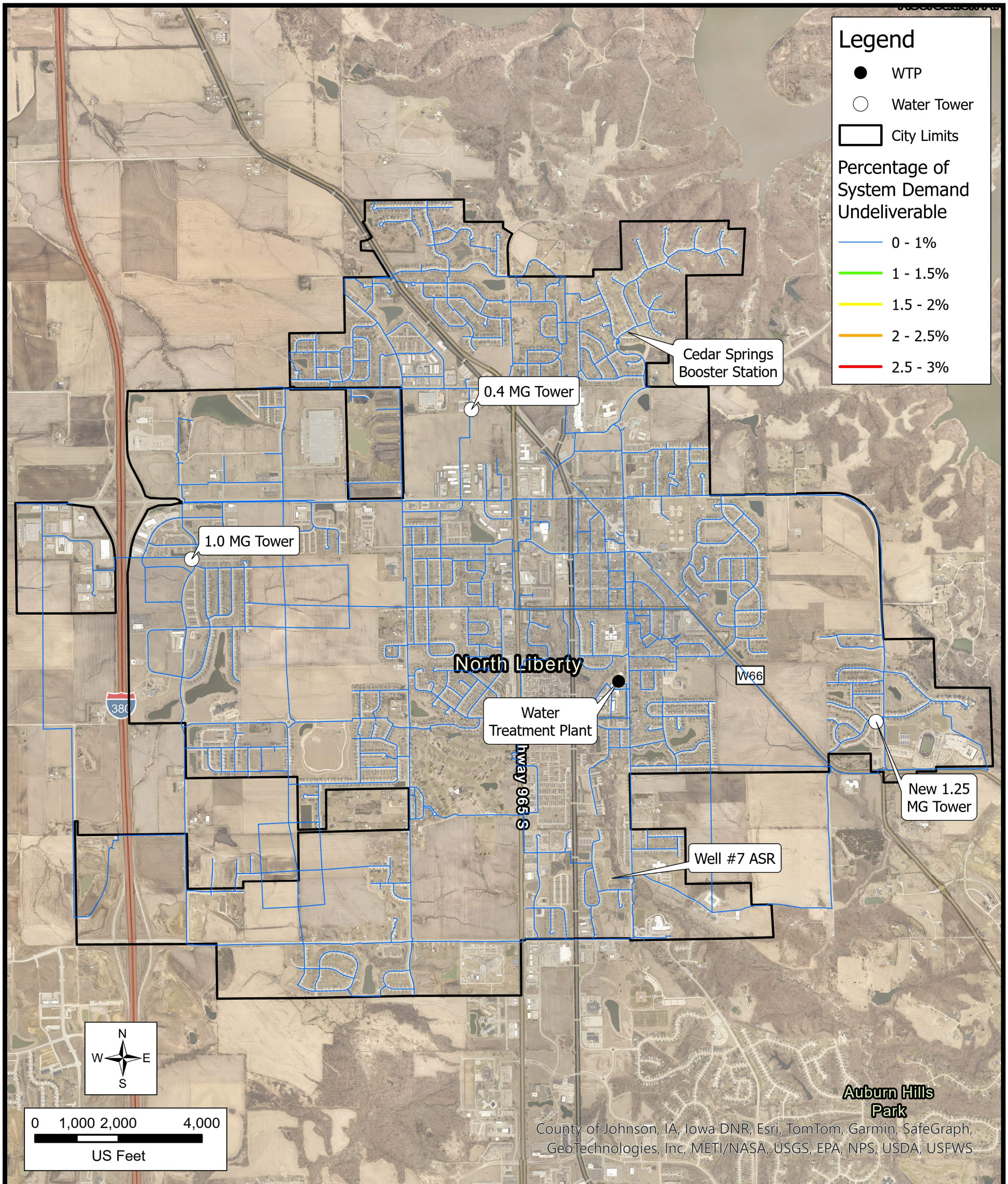
Table 6.05-1 Modeled Available Fire Flow on a 2045 PDD

C. Water Main Criticality

Figure 6.05-5 presents the model-predicted criticality analysis for the existing distribution system with 2045 PDDs. With distribution system improvements described in Sections 6.03 and 6.04 in place, all pipes are shown with criticality scores of 1 percent or less.

6.06 OPC

Table 6.06-1 presents the OPC for recommended water main improvements numbered according to Figure 6.03-1. The total OPC for all water main improvements recommended through 2045 is $3,288,000 in 2024 dollars. Costs associated with expanding the existing distribution system to serve growth areas were not evaluated as part of the report.



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2045 WATER MAIN CRITICALITY

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FIGURE 6.05-5
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Description	Water Main Improvement				
	Improvement No. 1	Improvement No. 2	Improvement No. 3	Improvement No. 4	Improvement No. 5
Opinion of Probable Construction Cost	$153,000	$80,000	$605,000	$173,000	$913,000
General Requirements (15%)	$23,000	$12,000	$91,000	$26,000	$137,000
Undefined Scope (20%)	$31,000	$16,000	$121,000	$35,000	$183,000
Construction Subtotal	**$207,000**	**$108,000**	**$817,000**	**$234,000**	**$1,233,000**
Contingencies (10%)	$21,000	$11,000	$82,000	$23,000	$123,000
Construction Total	**$228,000**	**$119,000**	**$899,000**	**$257,000**	**$1,356,000**
Engineering, Legal, and Administration (15%)	$34,000	$18,000	$135,000	$39,000	$203,000
Total Project Cost	**$262,000**	**$137,000**	**$1,034,000**	**$296,000**	**$1,559,000**

Table 6.06-1 Water Main Improvements OPC

Table 6.06-2 presents the OPC for recommended water storage improvements to provide capacity through 2045. The OPC is $8,393,000 in 2024 dollars.

Description	OPC
Water Storage	
1.25-MG Water Tower	$5,838,000
Subtotal	**$5,838,000**
Site Work (10%)	$584,000
Contingencies (15%)	$876,000
Construction Total	**$7,298,000**
Engineering, Legal, and Administration (15%)	$1,095,000
Opinion of Total Project Cost	**$8,393,000**

Table 6.06-2 Water Storage Improvements OPC

Project scheduling is discussed in Section 7 of this report.

SECTION 7
CONCLUSIONS AND RECOMMENDATIONS

7.01 SUMMARY OF RECOMMENDED IMPROVEMENTS AND ALTERNATIVES

The existing WTP was constructed in 2018 and was intended to serve a population of approximately 28,940, which is anticipated to be reached in 2028. The existing water supply, treatment, distribution and storage facilities were evaluated to identify an anticipated schedule for expanding the water system for current and projected water demands through 2045. The following is a summary of proposed improvements that would be needed through 2045. A schedule of when improvements are proposed based on projected population growth and related demand is presented in Section 7.04.

A. <u>Raw Water Supply Improvement Alternatives</u>

Raw water supply needs were evaluated based on whether the ASR well remains in service as an ASR well or if the ASR is converted to a production well. A summary of total well improvements is presented for both alternatives:

1. Alternative No. 1–ASR Remains in Service

   If the ASR well remains in service and does not provide future raw water supply, seven new Silurian wells at approximately 200 gpm each are recommended to maintain adequate well capacity through 2045 projected demands. Two wells are required for Phase 1A and five additional wells are required for Phase 2.

2. Alternative No. 2–ASR Well Conversion

   If the ASR (Well No. 7) is converted into a raw water supply well, it will provide 1,100 gpm of raw water supply. In addition to Well No. 7's conversion, a total of seven new wells from the Silurian aquifer at approximately 200 gpm each are recommended to maintain adequate well capacity through 2045 projected demands. Two wells are required for Phase 2 and five additional wells are required for Phase 3.

B. <u>Phase 1A WTP Improvements</u>

Recommended improvements to the WTP for Phase 1A are listed in the following.

1. Membrane replacement of the three existing NF skids.

2. 10 percent membrane buildout of the three skids to full capacity.

C. <u>Phase 2 WTP Improvements</u>

Recommended improvements to the WTP for Phase 2 are listed in the following.

1. Add one 2,100-gpm aerator.

2. Add one 770-gpm NF skid.

3. Add one 3,900-gallon sodium hydroxide (caustic) and one 155-gallon fluoride bulk storage tank.

4. Replacement of 6.4-mm sodium hydroxide feed pump tubing with 8.0-mm tubing.

5. Add one 1,667-gpm high service pump.

D. Phase 3 WTP Improvements

Recommended improvements to the WTP for Phase 3 are listed in the following.

1. Add one 770-gpm NF skid.

2. Add one 230-gallon antiscalant and one 230-gallon phosphate bulk storage tank.

E. Storage

To provide adequate storage capacity through 2045, a 1.25-MG water tower is recommended.

F. Water Main Improvements

Water main improvements recommended through 2045 are listed in the following.

1. Water main loop connecting Harlen Street to Forevergreen Road to improve hydraulic connectivity and mitigate service disruptions (approximately 1,800 feet of 12-inch water main).

2. Connect 8-inch water mains on 230th Street to Pheasant Lane to provide redundancy to the northern neighborhoods (approximately 150 feet of 8-inch water main crossing County Road W60).

3. Water main loop on northeast corner of North Liberty Road to mitigate service disruptions and increase available fire flow, particularly at Liberty High School (approximately 6,500 feet of 12-inch water main).

4. Water main loop connecting the southeast end of the Dubuque Street water main to East Tartan Drive to mitigate service disruptions to Liberty High School (approximately 2,300 feet of 8-inch water main).

5. Water main loop on Jasper Avenue (approximately 9,500 feet of 12-inch water main).

7.02 SUMMARY OF PROJECT COST OPINION AND SCHEDULE

A. Supply, Treatment, and Storage Improvements

A project improvement schedule based on previous sections of this Facility Plan for raw water supply, treatment, distribution and storage including associated OPC is presented in Tables 7.02-1 and 7.02-2. Table 7.02-1 accounts for the existing ASR well remaining in service. Table 7.02-2 accounts for converting the ASR well to a raw water production well. The estimated year presented in these two tables represents the year that the improvements would need to be completed.

Project Description	Estimated Year Completed	OPC
Phase 1A		
Two New Silurian Wells	2028	$6,610,000
Membrane Replacement and Buildout	2028	$1,270,000
Phase 2		
1.25-MG Water Tower	2031	$8,393,000
Five New Silurian Wells	2037	$11,815,000
Added Membrane Skid and Phase 2 Treatment Improvements	2037	$3,457,000
Total OPC		**$31,545,000**

Table 7.02-1 Alternative No. 1 Water Supply, Treatment, and Storage Projects with ASR Well in Service

Project Description	Estimated Year Completed	OPC
Phase 1A		
Well No. 7 Conversion	2028	$1,010,000
Membrane Replacement and Buildout	2028	$1,270,000
Phase 2		
Two New Silurian Wells	2028	$6,610,000
Added Membrane Skid and Phase 2 Treatment Improvements	2028	$3,457,000
1.25-MG Water Tower	2031	$8,393,000
Phase 3		
Five New Silurian Wells	2038	$11,815,000
Add Membrane Skid and Phase 3 Treatment Improvements	2038	$2,325,000
Total OPC		**$34,880,000**

Table 7.02-2 Alternative No. 2 Water Supply, Treatment, and Storage Projects

The total cost opinion for improvements through 2045 for Alternative No. 1, keeping the ASR well in service, is approximately 10 percent less than Alternative No. 2, converting the ASR well into a raw production well. The difference is due to additional costs for Alternative No. 2 of converting the ASR well to a supply well and the need for additional treatment capacity (Phase 3 improvements) for design year 2045. At the study phase of alternative evaluation, the expected accuracy range of this OPC is -20 to +40 percent based on the Association for the Advancement of Cost Engineering (AACE) International Recommended Practice 17R Cost Estimate Classification System. Typically, planning level cost opinions within 10 percent are considered equivalent.

B. Nonmonetary Factor Evaluation

Alternative Nos. 1 and 2 can also be evaluated on a nonmonetary basis considering the following factors:

1. Operational Complexity

Operational complexity pertains to the need for operator attention. Alternative No. 1 is considered less ideal because keeping the ASR well in service requires more operator attention to adjust water treatment production in the winter to inject water to the ASR well, recover all injected water in the summer, test recovered water quality, and report ASR well specific operating information to the IDNR. Alternative No. 1 requires more operator attention, operation of multiple components (water treatment and ASR well), and operation from the separately located ASR well facility. Alternative No. 2 (converting the ASR well to a raw water production well) simplifies operation.

2. Reliability

Reliability is defined as the ability to continuously process water. Converting Well No. 7 into raw production increases redundancy and reliability to the raw water supply. As a supply well, Well No. 7 could be used to in the winter months. Well No. 7 cannot be used for production during the winter months when it is being filled. Well No. 7 as an ASR well provides additional finished water pumping capacity, but that does rely on the single ASR well. Redundancy for the ASR well is achieved through increased production (24-hour operation) from the supply wells and WTP. With either alternative, the raw water supply capacity will need to be. While both alternatives are considered reliable, Alterative 2 is considered more reliable due to Well No. 7 being available as a supply well.

3. Operational Flexibility

Operational flexibility is the ability to be adapted to changing process conditions or external factors. Alternative No. 1 has less flexibility due to relying on a single ASR well. To provide redundancy described in earlier sections of this study, the ASR would need to be operated as originally designed by injecting water into the well during low demand months and recovering water from the aquifer during peak demand months, which are approximately May through September. Operating the ASR well any other way will not provide full capacity for reducing WTP production requirements in peak demand months. Alternative No. 2 provides more operational flexibility with an additional NF skid to provide more redundancy and the ability to produce higher quality water when one skid is out of service.

4. Expandability

Expandability is the capability for future expansion of facilities as the community grows and as industrial and commercial demand for water increases beyond the design capacity of the system in the 20-year planning period. Long term, Alternative No. 1 provides more expandability for the WTP beyond the 20-year planning period. Phase 3 improvements are not projected to be needed before 2045 with Alternative No. 1; whereas Phase 3 improvements are projected to be needed before 2045 with Alternative No. 2. Phase 3 includes a total of five NF skids, which is the maximum within the existing WTP footprint. Alternative No. 2 could allow for increased withdrawal from the Jordan aquifer and/or maintain pumping levels above the Tier 2 level longer. Alternative Nos. 1 and 2 are considered equal in terms of expandability.

5. Implementation

Implementation pertains to timing of making improvements to the water treatment system and the size of the projects needed. Alternative No. 2 is more capital intensive and requires a larger investment earlier on in the planning period. Through year 2027, Alternative No. 2 would require implementing Phase 1A and Phase 2 WTP expansions, in addition to converting the ASR well and constructing two new Silurian wells. Alternative No. 1 only requires the two additional Silurian wells and Phase 1A expansion of the WTP. The cost opinion for Alternative No. 1 is $7.88 million while Alternative No. 2 is $12.35 million. Obligating more funding or resources toward water supply improvements reduces funding or resources available for other capital improvement needs in the City. Alternative No. 1 is more favorable when implementation is considered.

6. Maintenance Requirements

Alternative No. 1 requires maintenance of the ASR well facility in addition to the WTP. The ASR well facility includes chemical feed and other appurtenances that require more maintenance than if the facility is converted to a water supply well. With Alternative No. 1, WTP production would need to increase in the winter to supply the system demand and inject water into the ASR well. With Alternative No. 2, WTP production would need to increase in the summer months to meet peak demands and replace the ASR well. Maintenance requirements for the WTP would be similar with either alternative. Overall, Alternative No. 2 is considered to have lower maintenance requirements.

7. Ability to Meet Regulations in the Future

The ability to meet regulations in the future pertains to the City’s Water Use Permit and IDNR regulations for maintaining the pumping water level for Jordan wells above Tier 2 levels. If Well No. 7 is converted to a production well, pumping from the Jordan aquifer would be distributed over more wells and a larger area. This could help reduce the maintain pumping water levels in the Jordans wells above Tier 2. Alternative No. 2 is considered more beneficial in helping maintain compliance with Tier 2 pumping levels without reducing pumping rates from the Jordan Aquifer.

8. Social Impacts

The social impact to consider for Alternative Nos. 1 and 2 is the potential acceptability by various stakeholders. Two areas of social impact include impact on rates and additional land needed for expanding well capacity. Alternative No. 2 will have a greater impact on rate payers since Alternative No. 2 has higher total capital costs during the 20-year planning period. Alternative Nos. 1 and 2 require equivalent well field expansions, which require collaborating with landowners to obtain easements for raw water main and acquiring land for wells. Because Alternative No. 2 has a greater impact on rate payers, Alternative No. 1 is considered to have more favorable social impacts.

Table 7.02-3 summarizes the nonmonetary evaluation criteria. A point is assigned to the alternative that is more favorable for each nonmonetary criteria evaluated. The composite score of Alternative No. 2 is greater, indicating a higher nonmonetary value than Alternative No. 1.

Criteria	Description	Alternative No. 1	Alternative No. 2
1	Operational Complexity	0	1
2	Reliability	0	1
3	Operational Flexibility	0	1
4	Expandability	1	1
5	Implementation	1	0
6	Maintenance Requirements	0	1
7	Ability to Meet Future Regulation	0	1
8	Social Impacts	1	0
	Composite Score	**3**	**6**

Table 7.02-3 Evaluation of Alternatives by Nonmonetary Criteria

B. Water Main Improvements

Unlike supply, treatment, and storage improvements, not all of the proposed water main improvements are needed based on population growth and related increased finished water demand. Water main improvements are recommended to increase redundancy, improve hydraulic connectivity, mitigate service disruptions, and provide service for projected development.

Timing of water main improvements is determined by several factors including, but not limited to, when and where development occurs across the system, criticality of the deficiency being addressed, water main age, the City's preference, and other factors related to distribution system growth. Note that water main Improvement No. 3, 12-inch Water Main Loop on North Liberty Road, is recommended to be completed by 2031 when the 1.25-MG tower is placed into service to improve water turn over. General recommended project timing for each proposed water main improvement is discussed in Section 6 and presented in Table 7.02-4.

Improvement No.*	Description	Years until Completed	Present Worth OPC
1	12-Inch Water Main Loop Between Harlen Street and Forevergreen Road	5 to 10	$262,000
2	8-Inch Water Main Between 230th Street and Pheasant Lane	0 to 5	$137,000
3	12-Inch Water Main Loop on North Liberty Road	0 to 5	$1,034,000
4	8-Inch Water Main Loop Between Dubuque Street and East Tartan Drive	0 to 5	$296,000
5	12-Inch Water Main Loop on Jasper Avenue	5 to 10	$1,559,000

*See Figure 6.04-1.

Table 7.02-4 Water Main Improvement Project Timeline

7.03 SUMMARY AND RECOMMENDATIONS

Alternative Nos. 1 and 2 were evaluated based on monetary and nonmonetary criteria. While Alternative No. 1 has a lower OPC, Alternative No. 2 had a higher rating based on the nonmonetary criteria. Alternative No. 2 will help reduce the stress on the Jordan aquifer by distributing pumping over more wells and a larger area. It also improves reliability and flexibility of the raw water supply by having another high capacity well. Given these benefits, Alternative No. 2 is recommended, which includes completing Phases 1A and 2 for supply and treatment by year 2028.

Based on the evaluations presented in this Facility Plan, the following recommendations are offered:

1. Proceed with increasing the raw water supply by completing the following improvements, with an estimated completion in 2028:

    a. Construct two additional Silurian wells and associated raw water main.

    b. Convert the existing ASR to a water supply well.

2. Proceed with increasing the water treatment capacity by completing the following improvements, with an estimated completion in 2028:

    a. Expand the capacity of the existing NF skids by 10 percent by adding membranes and replace the existing membrane elements as needed.

    b. Add a fourth NF skid and other WTP improvements identified in this Facility Plan.

3. Proceed with planning and budgeting for adding a new 1.25-MG water tower, with an estimated completion of 2031.

4. Proceed with planning and budgeting for water main Improvement Nos. 2 through 4 summarized in Table 7.02-4, to be completed within the next 5 years.

The concepts presented in this Facility Plan should be reviewed and discussed and decisions made regarding the specific features and components to be included in the selected plan. Part of the decision process will include deciding how quickly to expand the facilities to meet the growing needs of the community. The City should concur with the concepts as presented or direct that revised analyses be made. Following acceptance by the City, the Facility Plan should be submitted to the IDNR for review and approval. Following comment by the IDNR, the design phase of the selected project should be initiated, as appropriate.

Once a decision is reached, then discussions can proceed on various preliminary design aspects associated with the selected plan. Some recommendations and analyses discussed in this Facility Plan may merit more detailed examination. During the design development stage, numerous decision points will arise regarding specific features of the proposed project. It can then be decided which recommendations to include in the selected plan and which deviations to make from the concepts proposed by this analysis.

7.04 SCHEDULE

The following schedule is proposed for completing the water system improvements as outlined in this Facility Plan, presuming population growth is as projected. The City should continue to monitor population growth and adjust the schedule accordingly.

Project Milestone	Month and Year	OPC
Submit Facility Plan to IDNR	April 2025	
IDNR Facility Plan Review	April to December 2025	
Phases 1A and 2–Water Supply and Treatment		**$12,347,000**
Preliminary Design (concurrent with IDNR review)	August to December 2025	
Final Design	January to September 2026	
IDNR Review and Permitting	September to February 2026	
Bidding	February to March 2027	
Construction	April 2027 to November 2028	
Phase 2–Water Storage		**$8,393,000**
Project Design	July to June 2029	
IDNR Review and Permitting	July to December 2029	
Bidding	January to February 2030	
Construction	March 2030 to October 2031	
Water Main Improvements		**$1,467,000**
Project Design	January to October 2027	
IDNR Review and Permitting	November 2027 to February 2028	
Bidding	February to March 2028	
Construction	April 2028 to October 2029	

Table7.04-1 Proposed Project Schedule

7.05 FINANCING OPTIONS

The following are presented as typical funding/financing options for municipal water projects of this scale. The City should consult with a trusted financial advisor before selecting appropriate financing/funding for this project.

A. Drinking Water State Revolving Fund (DWSRF) Loan

The DWSRF loan program is administered by the IDNR and the Iowa Finance Authority. The loans have an interest rate that is updated each quarter. The fourth quarter 2024 interest rate for a standard term, tax exempt loan is 2.43 percent plus a 0.25 percent servicing fee. This totals an effective interest rate of 2.68 percent. The repayment period for a DWSRF loan is up to 20 years. There are additional regulations, applications, and permits required for this process, but it should be considered as a very viable source of funds for these improvements.

The DWSRF program offers a Planning and Design Loan option, which can provide a 0 percent interest loan for up to 3 years with no initiation or servicing fees. This loan can be used to pay for most costs related to project plan preparation, including engineering fees, soils investigations, and similar costs. At the end of the 3-year period, the loan is rolled into a DWSRF Construction Loan or is repaid when permanent financing is obtained.

The DWSRF program does require Davis Bacon wages, which set the minimum wage rates that must be paid during construction. This tends to increase the overall cost of the project, but the exact impact is project specific and difficult to predict. In addition, the American Iron and Steel requirement would apply, mandating that most steel and iron used on the project be produced in the United States. Build America, Buy America requirements may also apply to a DWSRF project. These requirements can also increase project costs. The program also requires that an environmental review process be completed before proceeding with construction of the project.

B. Municipal Bonds

General Obligation (GO) Bonds are supported by the ability of the city to impose property taxes sufficient to retire the bonds. Therefore, the risk to bond holders is minimal, and the interest rate is typically relatively low.

Municipalities are limited to having the amount of outstanding GO Bonds not to exceed a total percentage of total assessed property value. Due to the limitation and other available methods of financing municipal utilities, GO Bonds are typically reserved for financing projects in departments within the General Fund such as streets, library, fire station, swimming pool, and public works. Water projects may be financed through GO Bonds with revenues from the utility transferred to the General Fund for debt retirement. However, the municipality is still subject to the percentage limit.

Revenue Bonds are retired by the revenues generated from user rates. Because revenue projections are based on projected sales often at higher user rates, there is a degree of risk associated with the purchase of such bonds. As a result, the interest rate is typically higher than with GO Bonds, and a projection of excess revenues (coverage factor) is typically necessary to obtain the lowest interest rate.

C. Reserve Funds

The City may elect to offset a portion of the project cost using saved reserve funds from within the utility or other sources.

7.06 POTENTIAL IMPACT ON USER RATES

As with any capital-intensive water project, the financed portion as well and operational and maintenance expenses will need to be funded through user rates. A detailed evaluation of the potential impact of this project on user rates is beyond the scope of this study. The City should consult with a trusted financial advisor to provide guidance on which type of funding is recommended for the City, the preferred loan term, and the final impact on water user fees.

The City developed a financial forecasting model (included in Appendix D) to determine the estimated impacts on user rates to support the projects recommended in this Facility Plan. Based on this model, rate increases of 2 to 6 percent annually are needed between fiscal years 2026 and 2038, with an annual rate increase of 2 to 3 percent between fiscal years 2044 and 2057 to support phased projects and maintain a minimum reserve fund balance of approximately $2.5 million in the next 10 years and $8.0 to $9.0 million between 2045 and 2057.

APPENDIX A
KOMLINE-HARN SERVICE REPORT

310 Center Court
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P: (941) 488-9671 | **F:** (941) 488-9400
harnmainoffice@komline.com

SERVICE REPORT

ANNUAL MAINTENCE R/O TRAINS 1-3

City of North Liberty R/O WTP	ATTN: Greg Metternich Chief Operator	Date: 11/27/2023
433 South Front Street	Em: gmetternich@northlibertylowa.org	Ph: (319) 626-6719
North Liberty, IA 52317	Job#-Name: 23-2641M Annual Maint Services on R/O Trains	

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Greg,

Thank you for your hospitality during my visit. I hope this finds you doing well.

Annual maintenance services were completed on November 27th, 2023. An operating profile from each train was recorded and added to the data history sheet. Trends and data for each train were updated and added below for your review.

Train Instruments were verified and calibrated as required. Updated calibration sheets for each instrument are attached as a separate document.

This is one of the best-maintained and cleanest RO plants I service. The process room, supporting equipment, and systems are maintained consistently by qualified operators, technicians, and mechanics.

The feed pumps, antiscalant, and system components are without issue. There are no leaks. The control panels and instruments are in good condition and functioning nominally. The UPS backup systems are charged and online.

The trains are currently running nominally. Cleaning is not currently recommended and appears to be on a 3 to 5-year cycle. Continue to record and monitor operating data.

We appreciate the opportunity to continue our long-term relationship. Thank you for allowing us to service your water treatment systems. Please contact us if you have any questions or require any additional services.

Sincerely,

Troy Taylor

Troy Taylor
Technical Service Manager

Cc:
Keith Summerford
Service Coordinator
Report completed 1/3/2024

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North Liberty Train #1		Pre-CIP	Post-CIP	Data	Data	Mcon
Date	5/23/18	6/21/22	6/24/22	6/26/22	6/28/22	11/27/23
Name	HRO	KHRO	KHRO	KHRO	KHRO	KHRO
Time	9:45	8:30	11:00	8:30	8:30	11:30
Run Time Hours	4.7	11671.9	11685.6	11704.6	11718.8	15896.6
Low Service Boost Pump Hz	42.0	45.0	45.0	45.0	45.0	45.0
Feed Pump Hz	41.4	46.2	46.8	46.8	47.4	46.2
Interstage Boost Pump Hz	54.6	57.0	56.4	56.4	56.4	57.0
Feed Water Temp 'C	17.6	15.8	17.1	17.2	17.5	16.1
Feed pH	7.4	6.2	7.3	7.3	7.0	7.2
Pressure	PSI	PSI	PSI	PSI	PSI	PSI
Filter Inlet	41.6	45.2	45.3	45.3	45.5	47.0
Filter Outlet	40.1	42.9	43.8	44.1	42.2	45.0
Feed	89.9	105.2	109.5	109.2	109.8	108.0
Stage 1 Concentrate	70.9	87.1	92.4	91.5	91.9	90.7
Stage 2 Feed	101.2	122.1	125.2	126.1	125.8	124.8
Stage 2 Concentrate	88.6	108.0	114.4	113.8	113.7	112.2
Permeate	5.8	17.2	17.3	17.2	17.1	17.1
Delta Pressure	Dp	Dp	Dp	Dp	Dp	Dp
Filter	1.5	2.3	1.5	1.2	3.3	2.0
Stage 1	19.0	18.1	17.1	17.7	17.9	17.3
Stage 2	12.6	14.1	10.8	12.3	12.1	12.6
Transmembrane	84.2	88.0	92.2	92.0	92.7	90.9
Flow	GPM	GPM	GPM	GPM	GPM	GPM
Feed	823.0	822.9	823.3	825.1	824.4	824.2
Total Permeate	700.0	699.8	700.2	701.4	701.5	701.0
Permeate Stage 1	473.0	473.1	473.1	474.8	474.1	473.8
Permeate Stage 2	227.0	226.7	227.1	226.6	227.4	227.2
Concentrate	123.0	123.1	123.1	123.7	122.9	123.2
Conductivity	mS	µS	µS	µS	µS	µS
Feed	1461	1396	1425	1431	1412	1448
Interstage	3045	2727	2881	2892	2825	2950
Concentrate	7180	5759	6403	6458	6276	7172
Stage 1 Permeate	66	27	20	20	20	23
Stage 2 Permeate	156	73	60	60	60	58
Total Permeate	96	42	33	33	33	35
% Rejection	93.4%	97.0%	97.7%	97.7%	97.7%	97.6%
% Salt Passage	6.6%	3.0%	2.3%	2.3%	2.3%	2.4%
% Recovery	85.1%	85.0%	85.0%	85.0%	85.1%	85.1%

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Stage 1 Conductivity	mS	µS	µS	µS	µS	µS
V1-1	58	25	19	19	19	21
V1-2	61	27	19	20	20	22
V1-3	65	27	20	20	20	22
V1-4	66	28	20	20	20	23
V1-5	66	28	19	20	20	22
V1-6	67	27	19	19	19	22
V1-7	67	28	20	20	20	23
V1-8	61	27	19	19	19	21
V1-9	59	25	18	18	18	20
V1-10	58	25	18	18	18	20
V1-11	66	27	19	19	19	22
V1-13	59	25	18	18	18	20
V1-14	66	26	19	19	19	22
V1-15	78	30	23	23	23	25
V1-16	73	30	22	22	22	24
V1-17	77	30	22	22	22	24
Median	66.0	26.9	19.2	19.4	19.4	21.8
Average	65.4	27.2	19.5	19.6	19.7	22.0
Stage 2 Conductivity	**mS**	**µS**	**µS**	**µS**	**µS**	**µS**
V2-1	153	69	54	54	54	57
V2-2	162	74	58	58	58	62
V2-3	165	75	58	59	59	62
V2-4	149	71	61	61	61	61
V2-6	151	71	55	56	55	59
V2-7	147	71	57	57	58	60
V2-8	158	81	78	76	75	68
V2-9	152	71	62	63	62	62
Median	152.5	71.2	57.8	58.5	58.5	61.2
Average	154.6	72.9	60.2	60.5	60.1	61.3

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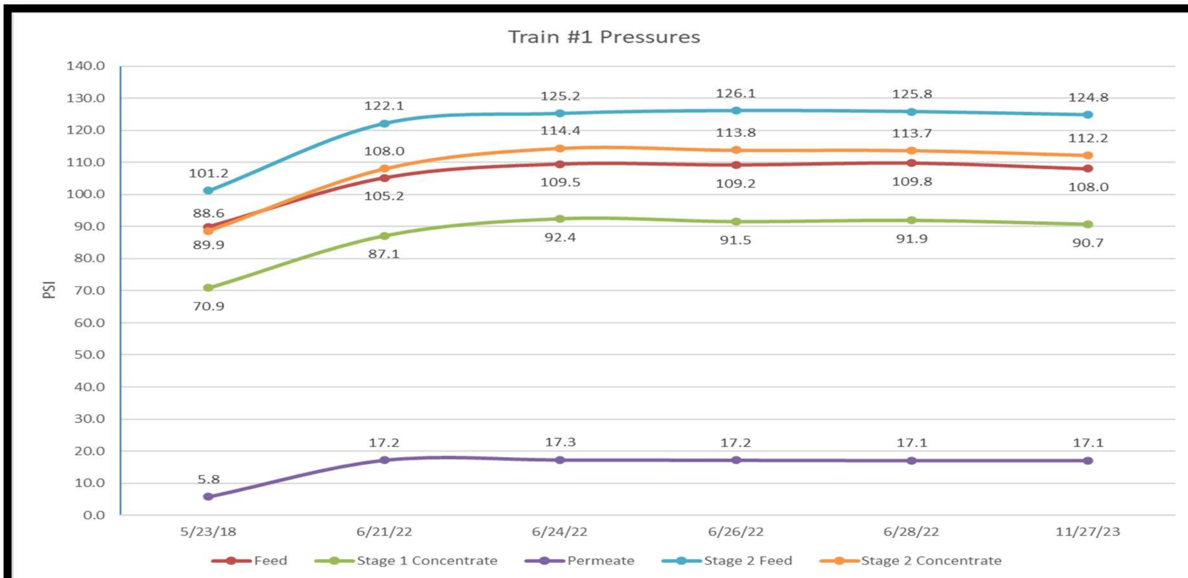

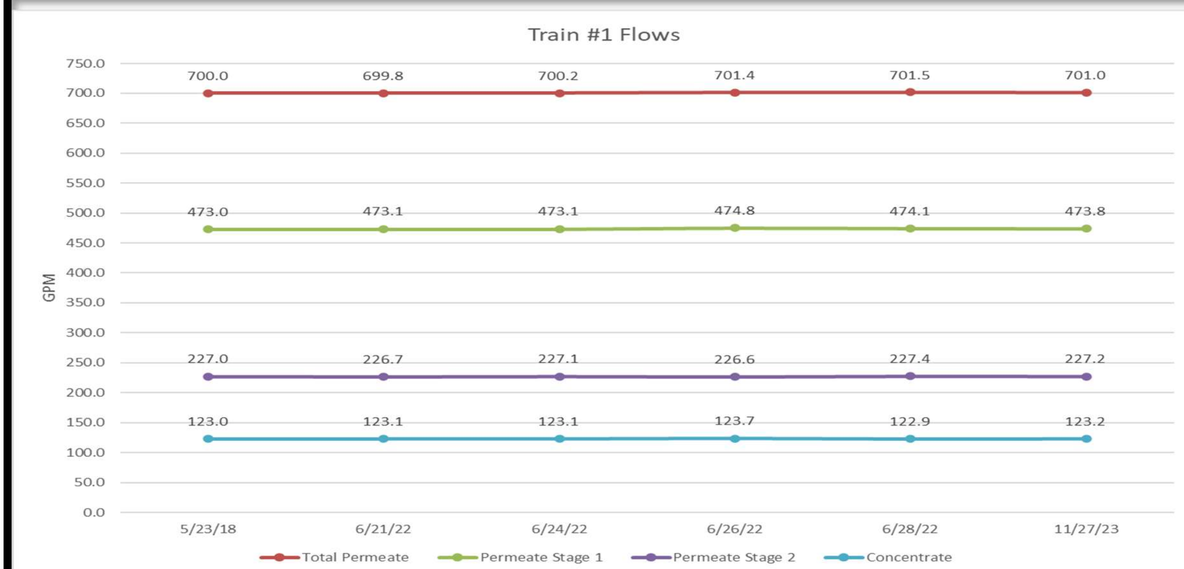

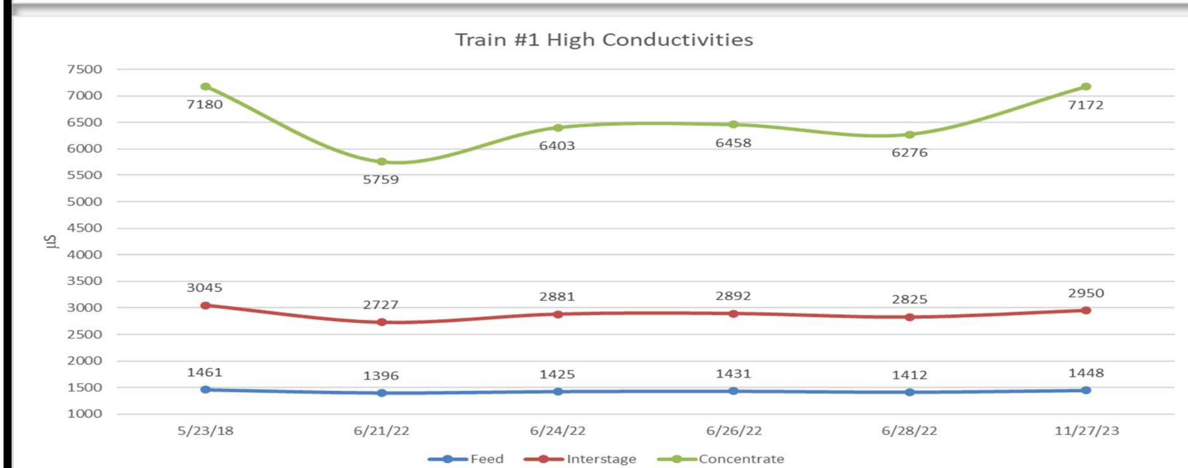

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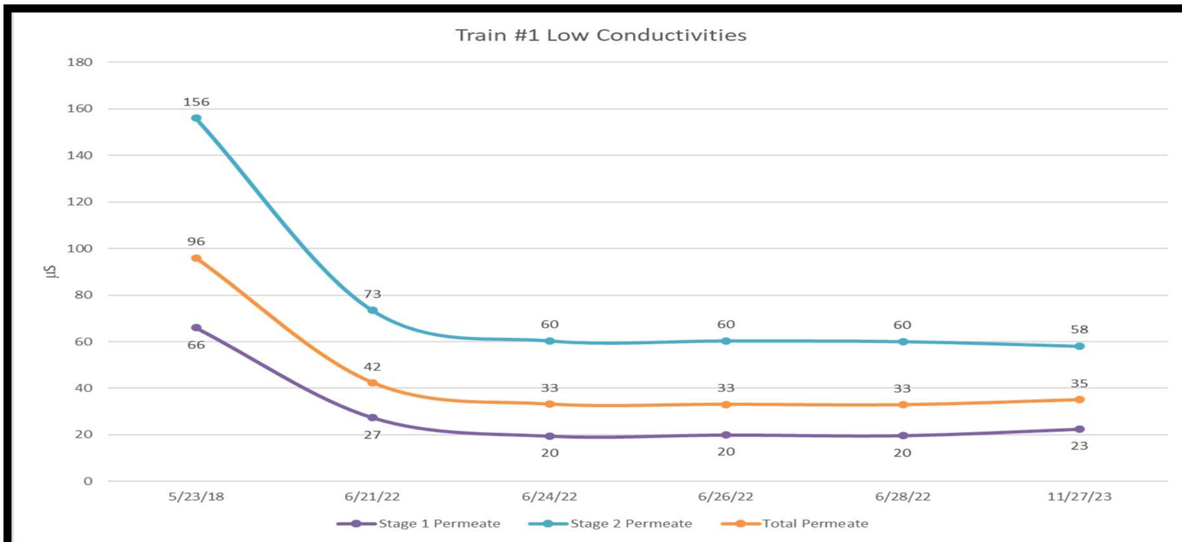

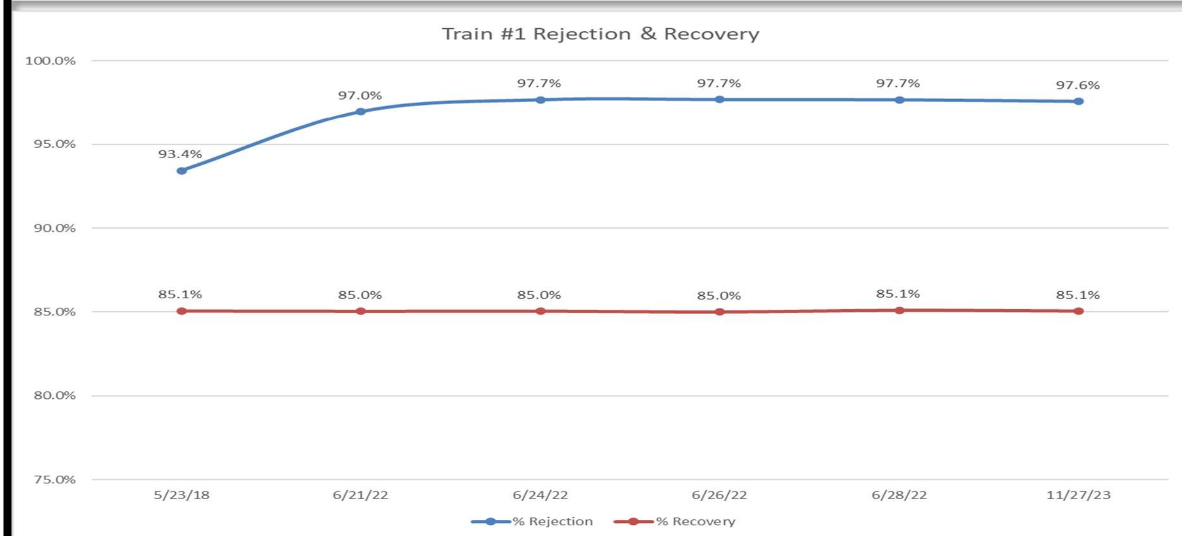

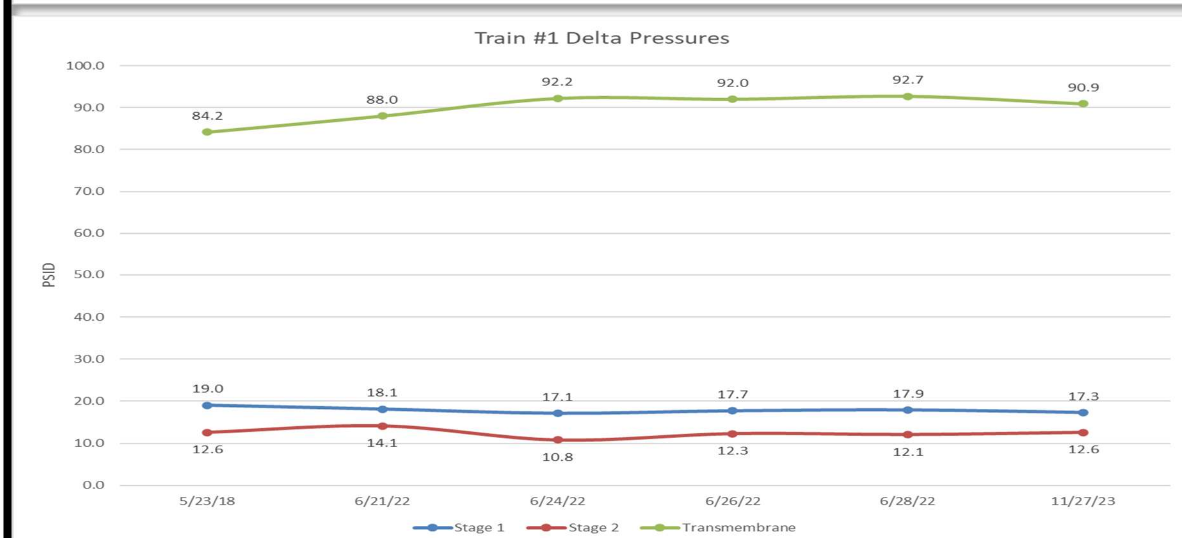

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North Liberty Train #2		Pre-CIP	Post-CIP	Data	Data	Mcon
Date	5/23/18	6/22/22	6/26/22	6/27/22	6/28/22	11/27/23
Name	Harn R/O	KHRO	KHRO	KHRO	NB	KHRO
Time	12:15	8:00	8:30	8:30	17:00	12:30
Run Time Hours	4.9	11945.5	11980.6	11994.5	12002.4	16143.5
Low Service Boost Pump Hz	45.0	45.0	45.0	45.0	45.0	45.0
Feed Pump Hz	45.6	45.6	46.2	45.6	45.6	45.6
Interstage Boost Pump Hz	54.6	56.4	56.4	56.4	57.0	56.4
Feed Water Temp 'C	17.0	16.3	17.1	18.1	17.8	16.3
Feed pH	7.3	7.3	7.3	7.4	7.0	7.2
Pressure	PSI	PSI	PSI	PSI	PSI	PSI
Filter Inlet	40.9	44.2	44.5	48.2	49.0	44.0
Filter Outlet	39.9	42.3	43.9	46.2	45.1	43.0
Feed	86.4	100.9	104.8	104.2	103.7	104.4
Stage 1 Concentrate	70.1	83.0	87.1	86.5	85.8	86.2
Stage 2 Feed	99.8	117.3	122.4	120.4	120.2	121.0
Stage 2 Concentrate	89.9	105.0	110.8	109.5	109.5	109.2
Permeate	5.0	17.3	17.4	17.2	17.0	17.2
Delta Pressure	Dp	Dp	Dp	Dp	Dp	Dp
Filter	1.0	1.9	0.6	2.0	3.9	1.0
Stage 1	16.3	17.9	17.7	17.7	17.9	18.2
Stage 2	9.9	12.3	11.6	10.9	10.7	11.8
Transmembrane	81.4	83.6	87.4	87.0	86.7	87.2
Flow	GPM	GPM	GPM	GPM	GPM	GPM
Feed	823.0	822.4	824.3	825.6	825.2	823.4
Total Permeate	700.0	700.0	701.2	702.3	701.3	700.4
Permeate Stage 1	473.0	472.7	474.9	475.5	474.8	473.1
Permeate Stage 2	227.0	227.3	226.3	226.8	226.5	227.3
Concentrate	123.0	122.4	123.1	123.3	123.9	123.0
Conductivity	mS	µS	µS	µS	µS	µS
Feed	1457	1389	1435	1444	1445	1443
Interstage	3017	2756	2907	2917	2900	3046
Concentrate	7110	5916	6470	6516	6500	7389
Stage 1 Permeate	64	28	20	21	21	25
Stage 2 Permeate	184	79	71	74	74	77
Total Permeate	101	44	36	38	38	42
% Rejection	93.1%	96.8%	97.5%	97.4%	97.4%	97.1%
% Salt Passage	6.9%	3.2%	2.5%	2.6%	2.6%	2.9%
% Recovery	85.1%	85.1%	85.1%	85.1%	85.0%	85.1%

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310 Center Court
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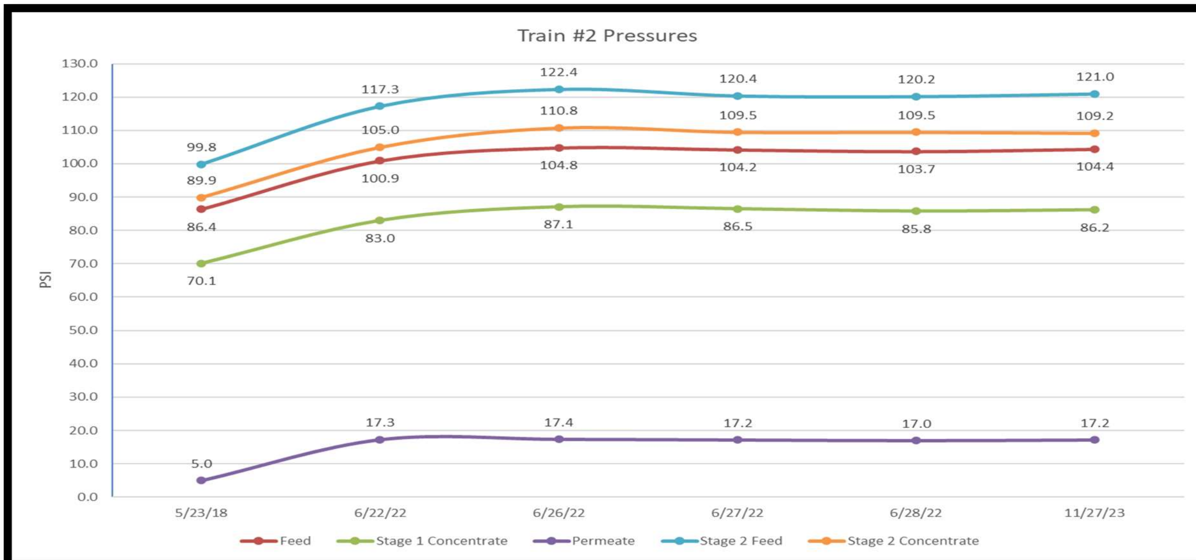
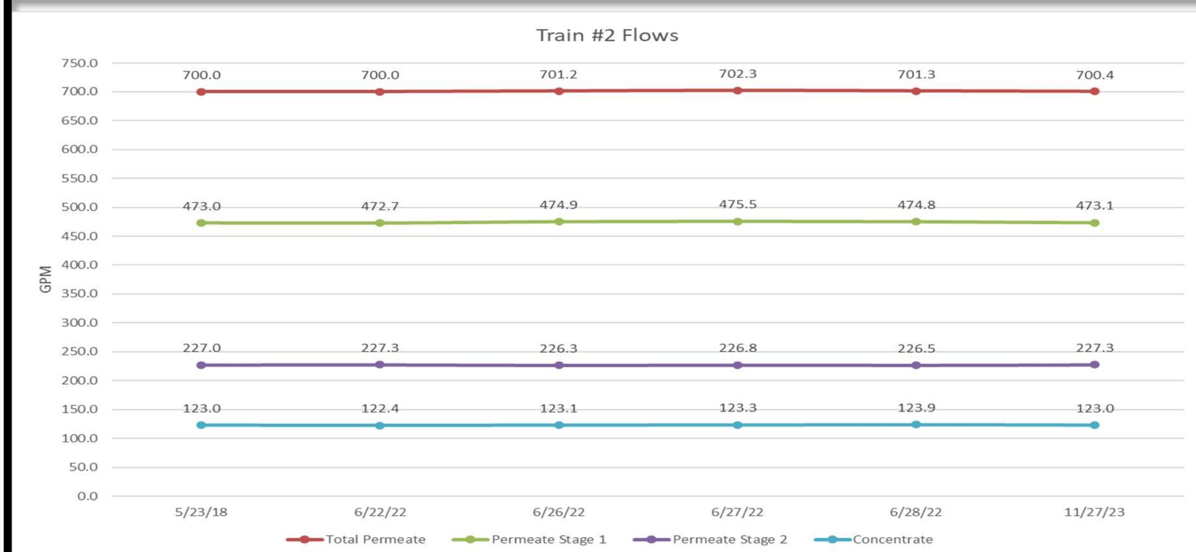
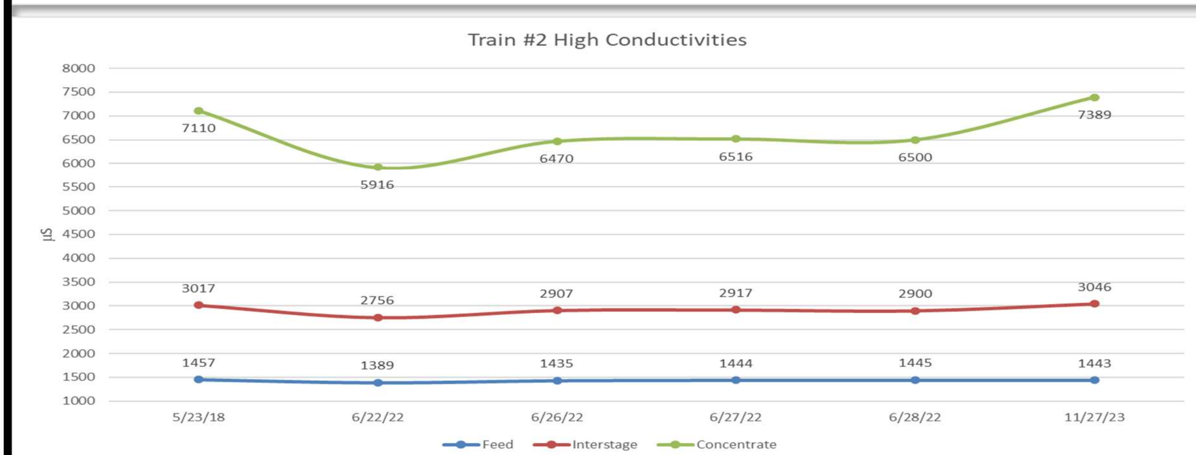
P: (941) 488-9671 | **F:** (941) 488-9400
harnmainoffice@komline.com

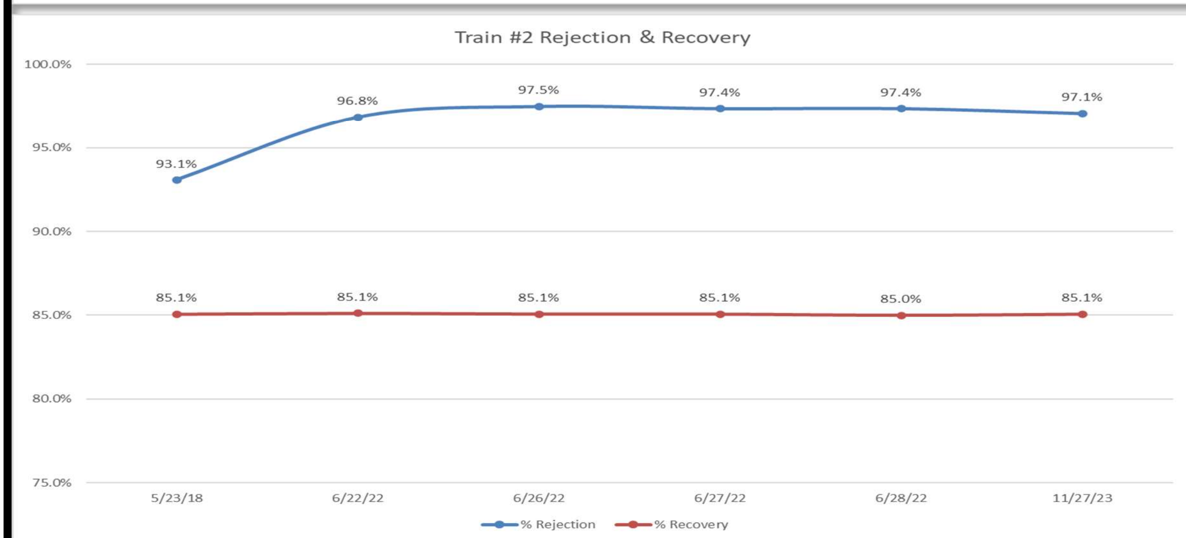
Stage 1 Conductivity	mS	µS	µS	µS	µS	µS
V1-1	64	28	20	22	22	26
V1-2	74	30	22	24	24	28
V1-3	60	26	18	19	19	24
V1-4	61	25	18	19	20	24
V1-5	59	26	19	21	21	24
V1-6	56	27	20	22	22	25
V1-7	56	25	18	19	19	23
V1-8	56	25	17	19	19	23
V1-9	55	24	17	18	18	22
V1-10	59	26	18	19	20	23
V1-11	66	28	21	23	23	27
V1-13	79	31	26	27	27	29
V1-14	71	28	21	23	22	26
V1-15	74	30	21	23	23	28
V1-16	67	27	19	21	21	25
V1-17	69	28	21	22	22	27
Median	62.5	27.0	19.8	21.1	21.1	25.3
Average	64.1	27.0	19.8	21.2	21.2	25.2
Stage 2 Conductivity	**mS**	**µS**	**µS**	**µS**	**µS**	**µS**
V2-1	177	81	81	85	83	81
V2-2	168	76	64	68	66	75
V2-3	171	77	67	71	70	74
V2-4	190	80	71	75	74	78
V2-6	192	82	70	75	73	80
V2-7	195	83	72	77	75	83
V2-8	179	80	70	74	72	79
V2-9	175	78	70	74	72	78
Median	178.0	79.8	70.1	74.3	72.5	78.5
Average	180.9	79.6	70.6	74.7	73.0	78.4

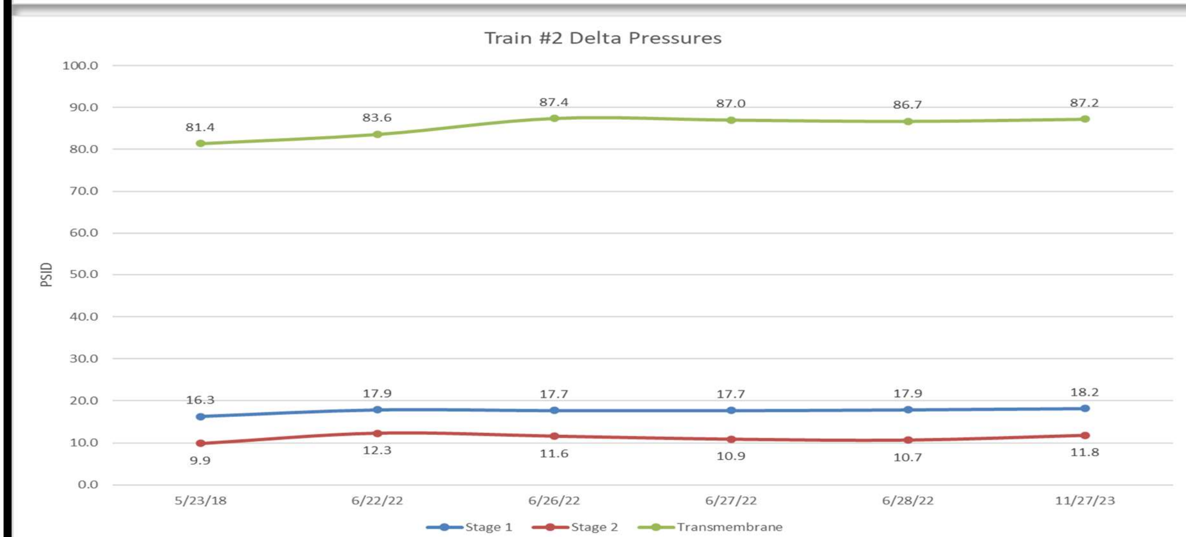

Train #2 Pressures
PSI
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
5/23/18
6/22/22
6/26/22
6/27/22
6/28/22
11/27/23
99.8
117.3
122.4
120.4
120.2
121.0
89.9
105.0
110.8
109.5
109.5
109.2
86.4
100.9
104.8
104.2
103.7
104.4
70.1
83.0
87.1
86.5
85.8
86.2
5.0
17.3
17.4
17.2
17.0
17.2
Feed
Stage 1 Concentrate
Permeate
Stage 2 Feed
Stage 2 Concentrate


Train #2 Flows
GPM
750.0
700.0
650.0
600.0
550.0
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
5/23/18
6/22/22
6/26/22
6/27/22
6/28/22
11/27/23
700.0
700.0
701.2
702.3
701.3
700.4
473.0
472.7
474.9
475.5
474.8
473.1
227.0
227.3
226.3
226.8
226.5
227.3
123.0
122.4
123.1
123.3
123.9
123.0
Total Permeate
Permeate Stage 1
Permeate Stage 2
Concentrate


Train #2 High Conductivities
µS
8000
7500
7000
6500
6000
5500
5000
4500
4000
3500
3000
2500
2000
1500
1000
5/23/18
6/22/22
6/26/22
6/27/22
6/28/22
11/27/23
7110
5916
6470
6516
6500
7389
3017
2756
2907
2917
2900
3046
1457
1389
1435
1444
1445
1443
Feed
Interstage
Concentrate


Train #2 Low Conductivities
µS
200
180
160
140
120
100
80
60
40
20
0
184
101
79
71
74
74
77
64
44
36
38
38
42
28
20
21
21
25
5/23/18
6/22/22
6/26/22
6/27/22
6/28/22
11/27/23
Stage 1 Permeate
Stage 2 Permeate
Total Permeate


Train #2 Rejection & Recovery
100.0%
95.0%
90.0%
85.0%
80.0%
75.0%
93.1%
96.8%
97.5%
97.4%
97.4%
97.1%
85.1%
85.1%
85.1%
85.1%
85.0%
85.1%
5/23/18
6/22/22
6/26/22
6/27/22
6/28/22
11/27/23
% Rejection
% Recovery


Train #2 Delta Pressures
PSID
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
81.4
83.6
87.4
87.0
86.7
87.2
16.3
17.9
17.7
17.7
17.9
18.2
9.9
12.3
11.6
10.9
10.7
11.8
5/23/18
6/22/22
6/26/22
6/27/22
6/28/22
11/27/23
Stage 1
Stage 2
Transmembrane

310 Center Court
Venice, FL 34285
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harnmainoffice@komline.com

North Liberty Train #3		Mcon	Pre-CIP	Post-CIP	Mcon
Date	5/22/18	8/17/21	6/21/22	6/28/22	11/27/23
Name	HRO	HRO	KHRO	KHRO	KHRO
Time	9:45	11:00	9:00	8:00	13:30
Run Time Hours	13.4	9541.6	11801.9	11874.0	15988.9
Low Service Boost Pump Hz	37.8	45.0	45.0	45.0	45.0
Feed Pump Hz	43.8	45.6	45.0	45.6	43.8
Interstage Boost Pump Hz	56.5	58.8	59.4	59.4	59.4
Feed Water Temp 'C	16.5	17.5	15.8	17.4	17.1
Feed pH	7.3	6.7	7.3	7.3	7.2
Pressure	PSI	PSI	PSI	PSI	PSI
Filter Inlet	33.5	42.8	44.3	45.3	48.0
Filter Outlet	32.0	40.2	42.1	43.5	46.0
Feed	84.1	100.8	101.5	105.0	102.2
Stage 1 Concentrate	66.5	82.0	81.5	86.0	82.6
Stage 2 Feed	100.2	120.6	122.7	126.1	121.7
Stage 2 Concentrate	89.1	108.3	109.1	114.0	109.8
Permeate	4.8	17.3	17.4	17.4	17.0
Delta Pressure	Dp	Dp	Dp	Dp	Dp
Filter	1.5	2.6	2.2	1.8	2.0
Stage 1	17.6	18.8	20.0	19.0	19.6
Stage 2	11.1	12.3	13.6	12.1	11.9
Transmembrane	79.3	83.5	84.1	87.6	85.2
Flow	GPM	GPM	GPM	GPM	GPM
Feed	823.0	822.5	823.4	823.2	824.8
Total Permeate	700.0	699.4	700.4	700.2	700.7
Permeate Stage 1	473.0	472.4	473.9	473.8	474.1
Permeate Stage 2	227.0	227.0	226.5	226.4	226.6
Concentrate	123.0	123.1	123.0	123.0	124.1
Conductivity	mS	µS	µS	µS	µS
Feed	1439	1398	1406	1418	1419
Interstage	2962	2738	2797	2846	2974
Concentrate	6990	6413	6034	6318	7245
Stage 1 Permeate	62	27	28	21	25
Stage 2 Permeate	145	73	77	64	73
Total Permeate	88	42	44	34	41
% Rejection	93.9%	97.0%	96.9%	97.6%	97.1%
% Salt Passage	6.1%	3.0%	3.1%	2.4%	2.9%
% Recovery	85.1%	85.0%	85.1%	85.1%	85.0%

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Stage 1 Conductivity	mS	µS	µS	µS	µS
V1-1	61	27	28	21	25
V1-2	62	28	28	21	25
V1-3	62	28	28	21	26
V1-4	59	27	27	20	24
V1-5	59	26	27	20	24
V1-6	61	27	27	20	24
V1-7	59	27	28	20	25
V1-8	57	27	28	20	25
V1-9	57	27	27	20	24
V1-10	62	28	28	21	25
V1-11	62	28	29	21	25
V1-13	62	28	29	21	26
V1-14	64	28	29	22	26
V1-15	64	29	29	22	26
V1-16	62	28	29	21	25
V1-17	65	28	29	21	25
Median	62.0	27.8	28.3	20.7	25.0
Average	61.1	27.6	28.0	20.6	25.0
Stage 2 Conductivity	**mS**	**µS**	**µS**	**µS**	**µS**
V2-1	120	59	60	49	59
V2-2	144	72	74	59	72
V2-3	147	72	76	62	73
V2-4	153	72	76	61	73
V2-6	143	76	79	68	77
V2-7	141	75	80	70	77
V2-8	151	73	77	67	74
V2-9	141	80	84	70	80
Median	143.5	72.6	76.4	64.5	73.5
Average	142.5	72.4	75.7	63.3	73.0

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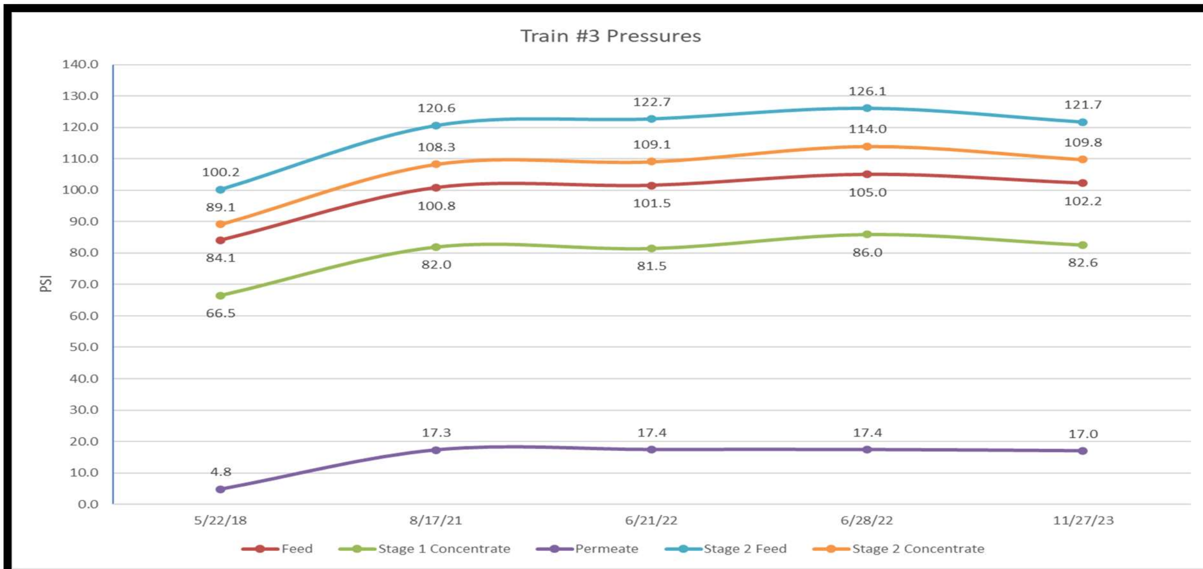
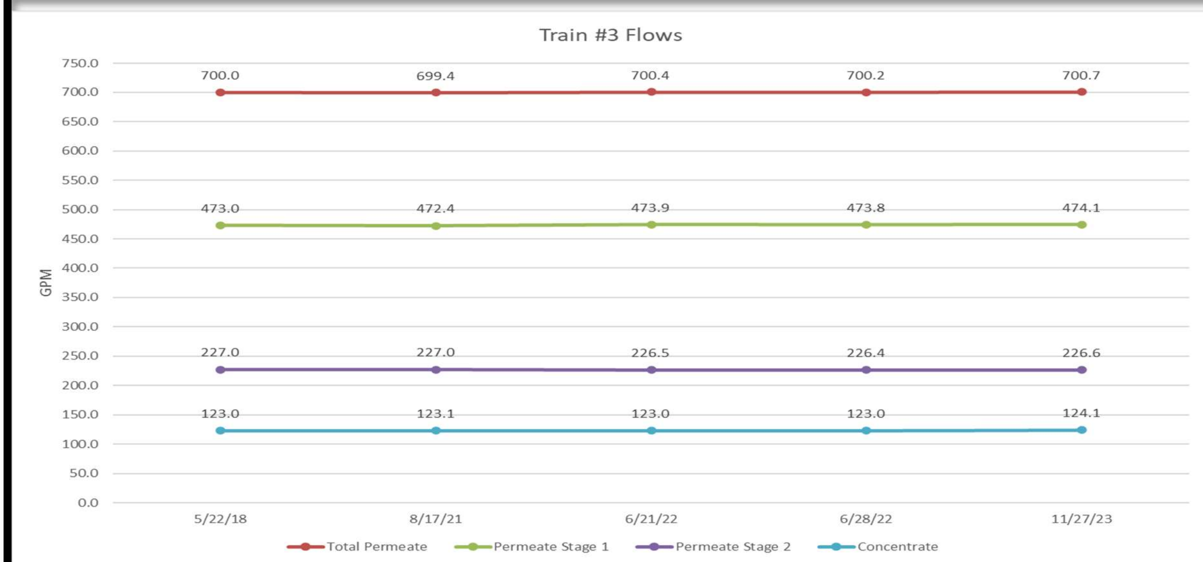
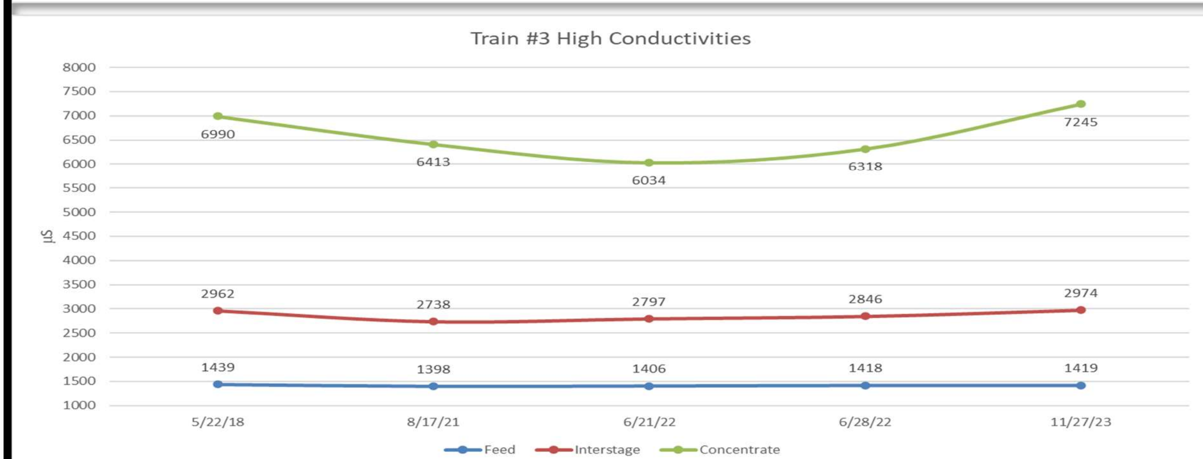
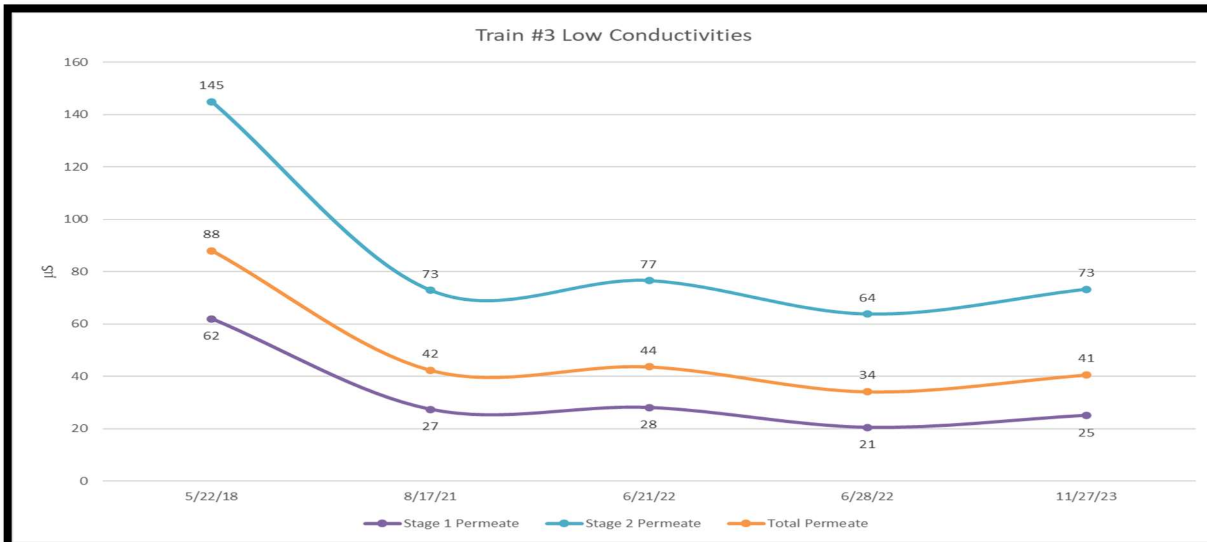
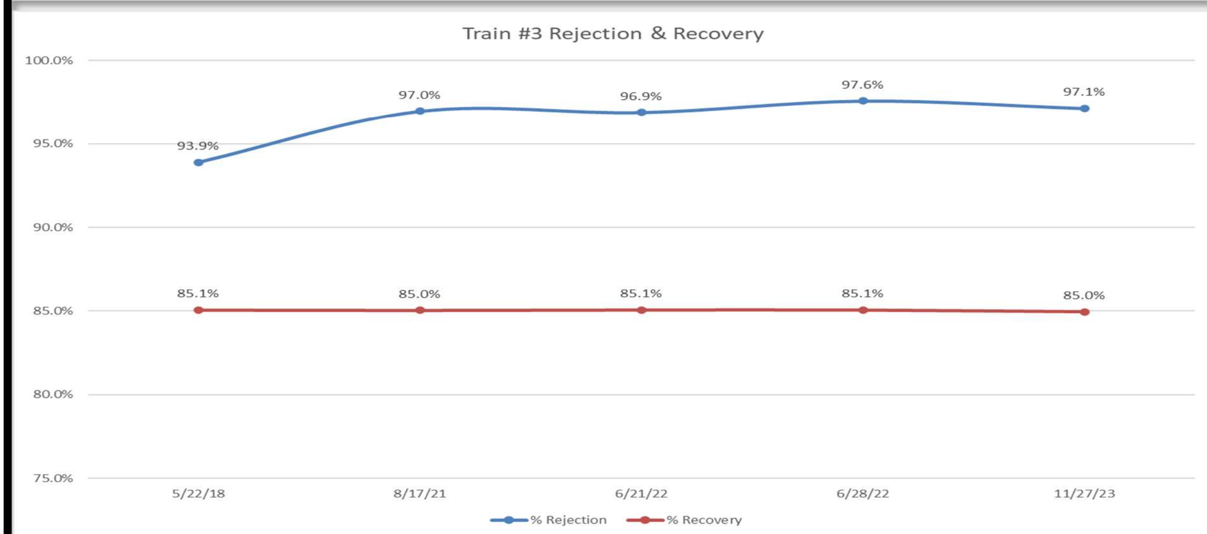
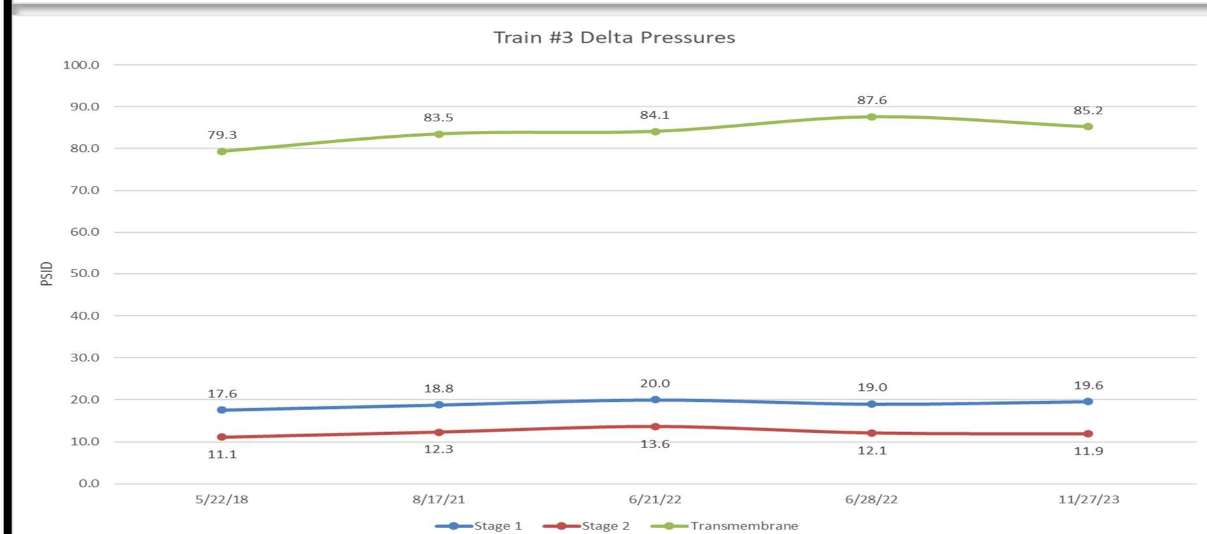







Train #3 Low Conductivities
µS
160
140
120
100
80
60
40
20
0
145
73
77
64
73
88
42
44
34
41
62
27
28
21
25
5/22/18
8/17/21
6/21/22
6/28/22
11/27/23
Stage 1 Permeate
Stage 2 Permeate
Total Permeate


Train #3 Rejection & Recovery
100.0%
95.0%
90.0%
85.0%
80.0%
75.0%
93.9%
97.0%
96.9%
97.6%
97.1%
85.1%
85.0%
85.1%
85.1%
85.0%
5/22/18
8/17/21
6/21/22
6/28/22
11/27/23
% Rejection
% Recovery


Train #3 Delta Pressures
PSID
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
20.0
10.0
0.0
79.3
83.5
84.1
87.6
85.2
17.6
18.8
20.0
19.0
19.6
11.1
12.3
13.6
12.1
11.9
5/22/18
8/17/21
6/21/22
6/28/22
11/27/23
Stage 1
Stage 2
Transmembrane

APPENDIX B
DIURNAL DEMAND PATTERNS

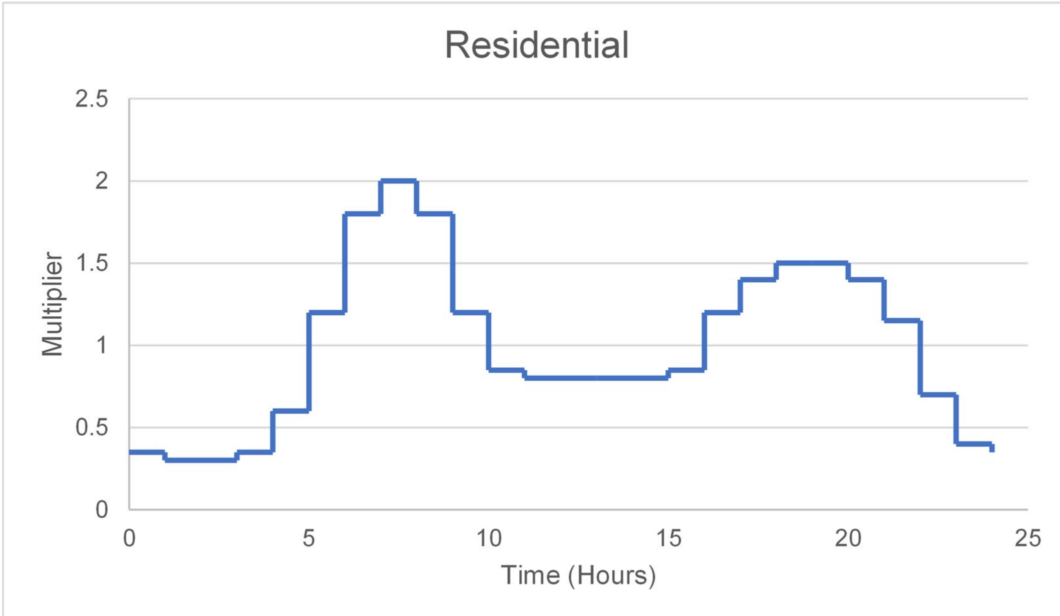


Figure B-1 24-Hour Residential Demand Pattern

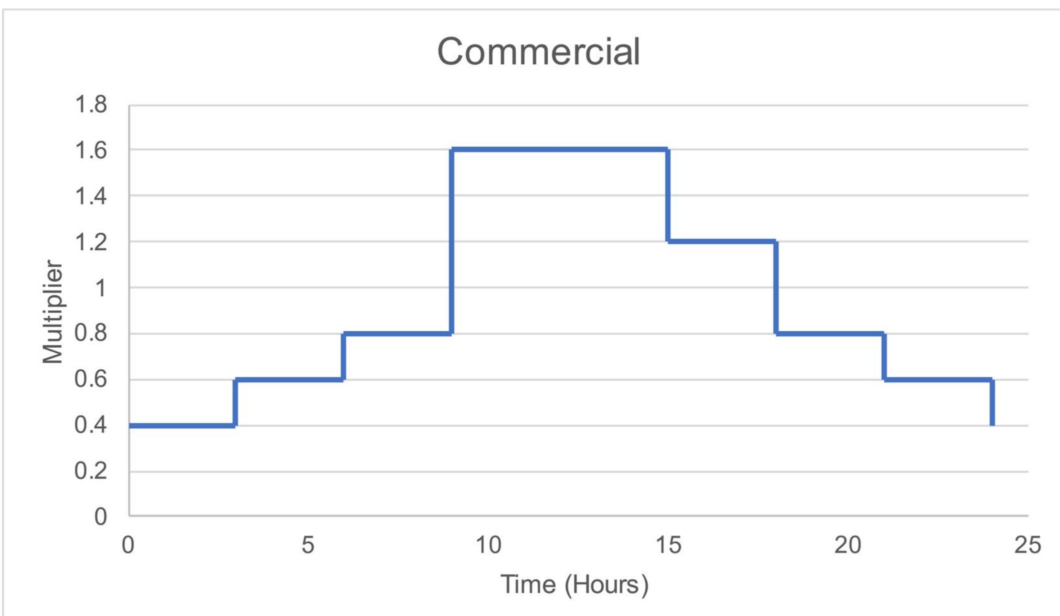


Figure B-2 24-Hour Commercial Demand Pattern

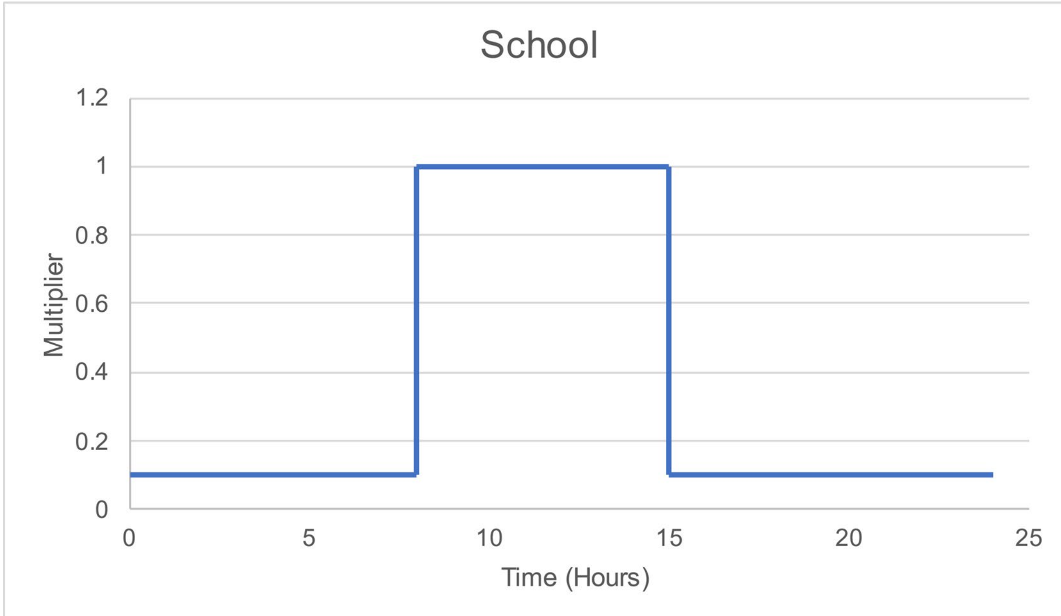


Figure B-3 24-Hour School Demand Pattern

APPENDIX C
JUNE 20, 2014, WATER TOWER LOCATIONS MEMORANDUM

FOX engineering

Aspen Business Park | 414 South 17th Street, Suite 107 | Ames, Iowa 50010

MEMO

TO: **Dean Wheatley**
Planning Director
City of North Liberty
3 Quail Creek Circle
North Liberty, IA 52317

FROM: **Steve Troyer, FOX Engineering**

COPY: **Ryan Heiar, City Administrator**
Kevin Trom, Shive-Hattery

DATE: **June 20, 2014**

RE: **Potential Water Tower Locations in Southeast Growth Area**

This memo summarizes our water distribution modeling activities to evaluate various water tower locations in the southeast growth area.

General Tower Location Considerations

When considering a tower location, many factors must be weighed before making a decision to proceed with design. Tower location should be based on water modeling data, local topography, and where the fire flow provided by the tower can be best utilized. Choosing a tower location based solely on available land or under political pressure may result in significant operational difficulties once the tower is brought online.

Arguably the most important factor in evaluating a potential tower site is how closely the water level in the proposed tower will mimic the water level in existing water towers if it is placed at that site. The hydraulic conditions in the distribution system dictate the water level experienced in each tower and this relationship can only be examined through computer modeling. Knowing how the towers react to each other under changing demand and water supply conditions enables us to place the new tower in a hydraulically favorable location. Without this knowledge, the existing tower(s) may become full while the new tower is several feet from full. This level differential results in storage that has been purchased but is not usable.

Water towers only provide increased fire flow availability in their local vicinity, but also extend the duration over which flow is available to the entire system. Therefore, fire flow needs of specific areas of the community must be considered. In theory, towers should be located near industrial parks, schools, apartment complexes, retirement communities, and hospitals to provide adequate fire flow availability. If the water tower cannot be located near these locations, appropriately sized water main should be extended to them and looped if possible.

Local topography also influences tower location selection. However, this factor is mostly related to reducing project cost associated with tower height. Locating a new water tower on the highest hill in the community is ideal because it reduces the amount of stem height that must be constructed to provide the same storage and fire flow, which reduces cost. As a result, low-lying land is less desirable.

Tower Locations

Five different tower locations were selected in the southeast growth area for evaluation. The tower locations are summarized as follows, and are shown on the attached figure. It should be noted that these tower locations are not intended to be precise, but more of a general location in the vicinity shown.

1. **High School Location #1**: Located west of North Liberty Road, across from the high school, near the high elevation point.
2. **High School Location #2:** Located east of the high school site, in the Scanlon development area, near the high elevation point.
3. **North Location:** Generally located west of North Liberty Road in the Scanlon development area, approximately 1400 ft west and 200 ft north of the intersection of North Liberty Road and Oak Lane NE.
4. **Dubuque St. Location:** Located near the intersection of Dubuque Street and Naples Ave. NE.
5. **South Tower Location**: Located in the south area of this development area, east of the WWTP approximately 1500 ft, at the highest point.

Evaluation of Tower Locations

Each of these tower locations were input into the model to see how the system would respond. The scenario used in the modeling assumed average day demand conditions with the entire SE Growth Area fully developed. Prior to final tower location selection, additional scenarios (e.g. average day demand at current conditions, peak day demand at future conditions, etc.) should also be modeled. The tower locations were evaluated based on tower height, fire flow availability at the high school, and how closely the predicted water level in mimics (or balances with) that of the existing towers. The table below summarizes the information for each proposed tower location.

Table 1. Tower Location Summary

No.	Location Description	Site Elevation (ft)	Fire Flow at High School (gpm)	Level Differential w/ 0.4 MG Tower
1	High School Location #1	809±	4,000±	-1.5 to -2.5 ft±
2	High School Location #2	800±	4,330±	-1.5 to +2 ft±
3	North Location	778±	2,860±	-1 to -2 ft±
4	Dubuque St. Location	766±	3,040±	-1 to -2.5 ft±
5	South Tower Location	818±	2,110±	-1.5 to 0 ft

Where comparing the tower level differential, each tower location balances reasonably well with the existing towers. In general, water level differentials less than 2-3 feet are acceptable. Each of the tower locations is within that range. Tower location No. 2 has the largest differential range, from -1.5 to +2 ft. This may be due to the fact that the model was connected to an 8" water line in the Scanlon development area east of the school. If the tower were to be located there, that water line should be increased to 12". The south tower location (No. 5) balances most closely with the existing towers.

When considering tower height, location No. 5 (South Location) has the highest ground elevation and therefore the shortest height. Locations No. 1 and No. 2 were reasonably close, within 9 and 18 ft respectively. It should be noted that in the general vicinity of location No. 2, there are points with higher ground elevations closer to 820 ft. Tower No. 3 location is 30 ft or more lower than the highest elevations, while location No. 4 is more than 40 ft lower than. While the tower height at location No. 1 would be approximately 110 ft, the tower height at location No. 4 would be more than 150 ft. For comparison purposes, the existing 1.0 MG tower on the west side of tower is approximately 127 ft high.

When considering the fire flow availability at the high school site, tower locations No. 1 and No. 2 are closest to the high school and therefore result in the highest available fire flow. Tower location No. 4 is reasonable close to the school, but has significantly less fire flow. This could be improved significantly by increase the water main size between the tower and school. As expected, the tower locations furthest from the school (No. 3 and No. 5) have the lowest available fire flow.

Another factor when considering tower location is the amount and size of additional water main required to connect the tower to the system. Since there are no existing water mains in this area, it was assumed that the towers would be located next to future water mains and there would be no significant water main cost difference between the tower locations.

Summary of Evaluation

Based on the evaluation of the 5 tower locations presented here, tower location No. 1 is the most favorable. It balances reasonably well with the existing towers, has one of the highest elevations, and provides good fire flow to the high school. Tower location No. 2 is reasonably similar to location No. 1 in terms of the parameters evaluated, but it is on the edge of the city limits and would provide less benefit to the development areas west of the school. Before final selection of a site, some additional evaluation and modeling may be beneficial.

APPENDIX D
2025 WATER FACILITY PLAN, FINANCIAL FORECASTING MODEL

2025 Water Facility Plan

Financial Forecasting Model

WATER OPERATING FUND	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	FY33	FY34	FY35	FY36	FY37	FY38	FY39	FY40
	Actual	Budget	Budget	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated
Budget Inflation Rate		1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Number of Accounts	9,836	9,758	9,904	10,053	10,204	10,357	10,512	10,670	10,830	10,992	11,157	11,325	11,494	11,667	11,842	12,019	12,200
Gallons Sold	446,336,000	434,826,000	475,000,000	482,125,000	489,356,875	496,697,228	504,147,687	511,709,902	519,385,550	527,176,334	535,083,979	543,110,238	551,256,892	559,525,745	567,918,631	576,437,411	585,083,972
Proposed Rate Increase	0%	0%	6%	5%	5%	5%	4%	4%	4%	3%	3%	3%	2%	2%	0%	0%	0%
Base Rate	$ 17.44	$ 17.44	$ 18.49	$ 19.41	$ 20.38	$ 21.40	$ 22.26	$ 23.15	$ 24.07	$ 24.79	$ 25.54	$ 26.30	$ 26.83	$ 27.37	$ 27.37	$ 27.37	$ 27.37
Rate/1000 Gallons	$ 7.01	$ 7.01	$ 7.43	$ 7.80	$ 8.19	$ 8.60	$ 8.94	$ 9.30	$ 9.67	$ 9.96	$ 10.26	$ 10.57	$ 10.78	$ 11.00	$ 11.00	$ 11.00	$ 11.00
Revenues																	
Water Sales	$ 4,324,304	$ 4,268,643	$ 4,842,596	$ 5,160,997	$ 5,500,332	$ 5,861,979	$ 6,187,905	$ 6,531,953	$ 6,895,129	$ 7,208,513	$ 7,536,140	$ 7,878,657	$ 8,156,774	$ 8,444,708	$ 8,571,379	$ 8,699,949	$ 8,830,449
Sales Tax	$ 269,555	$ 256,119	$ 290,556	$ 309,660	$ 330,020	$ 351,719	$ 371,274	$ 391,917	$ 413,708	$ 432,511	$ 452,168	$ 472,719	$ 489,406	$ 506,682	$ 514,283	$ 521,997	$ 529,827
Connection Fees/Permits	$ 71,145	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000
Use of Money	$ 29,494	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000
Miscellaneous	$ 4,439	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500
Transfers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Accounts Receivable/Payable	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenues	**$ 4,698,937**	**$ 4,650,262**	**$ 5,258,652**	**$ 5,596,157**	**$ 5,955,852**	**$ 6,339,198**	**$ 6,684,680**	**$ 7,049,370**	**$ 7,434,337**	**$ 7,766,524**	**$ 8,113,808**	**$ 8,476,877**	**$ 8,771,680**	**$ 9,076,891**	**$ 9,211,162**	**$ 9,347,446**	**$ 9,485,776**
Expenditures																	
Budget Inflation Rate		3.31%	8.19%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Personnel Services	$ 794,913	$ 853,578	$ 896,815	$ 941,656	$ 988,739	$ 1,038,175	$ 1,090,084	$ 1,144,588	$ 1,201,818	$ 1,261,909	$ 1,325,004	$ 1,391,254	$ 1,460,817	$ 1,533,858	$ 1,610,551	$ 1,691,078	$ 1,775,632
Services & Commodities	$ 1,810,708	$ 1,631,930	$ 1,761,820	$ 1,849,911	$ 1,942,407	$ 2,039,527	$ 2,141,503	$ 2,248,578	$ 2,361,007	$ 2,479,058	$ 2,603,011	$ 2,733,161	$ 2,869,819	$ 3,013,310	$ 3,163,976	$ 3,322,174	$ 3,488,283
Capital	$ -	$ -	$ -	$ 75,000	$ 75,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000	$ 50,000
Transfers																	
Equipment Revolving	$ -	$ 30,000	$ 50,000	$ 210,000	$ 125,000	$ 176,000	$ 190,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000	$ 100,000
Computer Revolving	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,500	$ 1,650	$ 1,650	$ 1,650	$ 1,650	$ 1,650	$ 1,800	$ 1,800	$ 1,800	$ 1,800	$ 1,800
Capital Reserve	$ 215,000	$ 80,000	$ 255,000	$ 200,000	$ 180,000	$ 80,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000
Revenue Debt	$ 1,274,841	$ 1,626,025	$ 1,625,168	$ 1,503,240	$ 1,500,000	$ 1,497,340	$ 1,494,240	$ 1,490,700	$ 1,487,720	$ 1,484,280	$ 1,480,380	$ 1,477,020	$ 1,474,180	$ 1,470,840	$ -	$ -	$ -
GO Debt	$ 292,478	$ 291,853	$ 296,153	$ 45,078	$ 44,028	$ 42,978	$ 41,928	$ 40,878	$ 44,828	$ 43,628	$ 42,428	$ 41,228	$ -	$ -	$ -	$ -	$ -
Billing & Accounting	$ 261,562	$ 290,022	$ 311,947	$ 327,544	$ 343,922	$ 361,118	$ 379,174	$ 398,132	$ 418,039	$ 438,941	$ 460,888	$ 483,932	$ 508,129	$ 533,535	$ 560,212	$ 588,223	$ 617,634
Upcoming Projects																	
Repaint Water Tower #2 & Water Maintenance Facility Expansion [$3.5 million GO]					$ 426,496	$ 426,354	$ 428,225	$ 429,585	$ 430,425	$ 426,651	$ 426,609	$ 430,187	$ 428,992	$ 427,163			
Water Facilities Expansion, Phase 1A & 2 (partial) [$12.4 million SRF]						$ 774,758	$ 844,006	$ 844,452	$ 844,452	$ 844,006	$ 844,353	$ 844,217	$ 844,837	$ 844,936	$ 844,514	$ 844,812	$ 844,552
Water Facilities Expansion, Phase 2 (partial) [$8.4 million SRF]									$ 524,836	$ 571,746	$ 572,048	$ 572,048	$ 571,746	$ 571,981	$ 571,889	$ 572,309	$ 572,376
Water Facilities Expansion, Phase 3 [$14.2 million SRF]															$ 887,223	$ 966,523	$ 967,034
Total Expenditures	**$ 4,651,002**	**$ 4,804,908**	**$ 5,198,403**	**$ 5,153,929**	**$ 5,627,091**	**$ 6,487,750**	**$ 6,810,660**	**$ 6,898,564**	**$ 7,614,776**	**$ 7,851,868**	**$ 8,106,371**	**$ 8,324,698**	**$ 8,510,319**	**$ 8,747,424**	**$ 7,990,165**	**$ 8,336,919**	**$ 8,617,311**
Net Change in Fund Balance	**$ 47,935**	**$ (154,647)**	**$ 60,249**	**$ 442,227**	**$ 328,761**	**$ (148,552)**	**$ (125,981)**	**$ 150,805**	**$ (180,439)**	**$ (85,345)**	**$ 7,437**	**$ 152,179**	**$ 261,361**	**$ 329,467**	**$ 1,220,997**	**$ 1,010,527**	**$ 868,465**
Beginning Fund Balance	$ 2,042,376	$ 2,090,310	$ 1,935,664	$ 1,995,913	$ 2,438,140	$ 2,766,901	$ 2,618,349	$ 2,492,368	$ 2,643,173	$ 2,462,735	$ 2,377,390	$ 2,384,827	$ 2,537,006	$ 2,798,367	$ 3,127,834	$ 4,348,831	$ 5,359,358
Ending Fund Balance	**$ 2,090,310**	**$ 1,935,664**	**$ 1,995,913**	**$ 2,438,140**	**$ 2,766,901**	**$ 2,618,349**	**$ 2,492,368**	**$ 2,643,173**	**$ 2,462,735**	**$ 2,377,390**	**$ 2,384,827**	**$ 2,537,006**	**$ 2,798,367**	**$ 3,127,834**	**$ 4,348,831**	**$ 5,359,358**	**$ 6,227,822**
% Reserved	44.94%	40.29%	38.39%	47.31%	49.17%	40.36%	36.60%	38.31%	32.34%	30.28%	29.42%	30.48%	32.88%	35.76%	54.43%	64.28%	72.27%
Personnel Cost in $	$ 1,056,475	$ 1,143,600	$ 1,208,762	$ 1,269,200	$ 1,332,660	$ 1,399,293	$ 1,469,258	$ 1,542,721	$ 1,619,857	$ 1,700,850	$ 1,785,892	$ 1,875,187	$ 1,968,946	$ 2,067,393	$ 2,170,763	$ 2,279,301	$ 2,393,266
Personnel % of Water	22.72%	23.80%	23.25%	24.63%	23.68%	21.57%	21.57%	22.36%	21.27%	21.66%	22.03%	22.53%	23.14%	23.63%	27.17%	27.34%	27.77%
Debt Service Coverage																	
Net Revenue/All Revenue Debt	1.44	1.15	1.41	1.65	1.79	1.28	1.31	1.40	1.21	1.24	1.29	1.34	1.36	1.38	1.68	1.57	1.51
Required Coverage	1.25	1.25	1.25	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Difference (Actual vs. Required)	**0.19**	**(0.10)**	**0.16**	**0.55**	**0.69**	**0.18**	**0.21**	**0.30**	**0.11**	**0.14**	**0.19**	**0.24**	**0.26**	**0.28**	**0.58**	**0.47**	**0.41**

2025 Water Facility Plan

Financial Forecasting Model

WATER OPERATING FUND	FY41	FY42	FY43	FY44	FY45	FY46	FY47	FY48	FY49	FY50	FY51	FY52	FY53	FY54	FY55	FY56	FY57
	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated	Estimated
Budget Inflation Rate	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%	1.50%
Number of Accounts	12,383	12,569	12,757	12,948	13,143	13,340	13,540	13,743	13,949	14,158	14,371	14,586	14,805	15,027	15,253	15,481	15,714
Gallons Sold	593,860,232	602,768,135	611,809,657	620,986,802	630,301,604	639,756,128	649,352,470	659,092,757	668,979,148	679,013,836	689,199,043	699,537,029	710,030,084	720,680,536	731,490,744	742,463,105	753,600,051
Proposed Rate Increase	0%	0%	0%	0%	3%	3%	3%	2%	2%	2%	2%	2%	2%	2%	2%	2%	2%
Base Rate	$ 27.37	$ 27.37	$ 27.37	$ 27.37	$ 28.19	$ 29.03	$ 29.90	$ 30.50	$ 31.11	$ 31.74	$ 32.37	$ 33.02	$ 33.68	$ 34.35	$ 35.04	$ 35.74	$ 36.45
Rate/1000 Gallons	$ 11.00	$ 11.00	$ 11.00	$ 11.00	$ 11.33	$ 11.67	$ 12.02	$ 12.26	$ 12.50	$ 12.75	$ 13.01	$ 13.27	$ 13.53	$ 13.80	$ 14.08	$ 14.36	$ 14.65
Revenues																	
Water Sales	$ 8,962,905	$ 9,097,349	$ 9,233,809	$ 9,372,316	$ 9,798,288	$ 10,243,620	$ 10,709,193	$ 11,087,227	$ 11,478,607	$ 11,883,801	$ 12,303,300	$ 12,737,606	$ 13,187,244	$ 13,652,753	$ 14,134,695	$ 14,633,650	$ 15,150,218
Sales Tax	$ 537,774	$ 545,841	$ 554,029	$ 562,339	$ 587,897	$ 614,617	$ 642,552	$ 665,234	$ 688,716	$ 713,028	$ 738,198	$ 764,256	$ 791,235	$ 819,165	$ 848,082	$ 878,019	$ 909,013
Connection Fees/Permits	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000	$ 105,000
Use of Money	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000	$ 20,000
Miscellaneous	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500	$ 500
Transfers	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Accounts Receivable/Payable	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Total Revenues	**$ 9,626,180**	**$ 9,768,690**	**$ 9,913,338**	**$ 10,060,155**	**$ 10,511,685**	**$ 10,983,738**	**$ 11,477,244**	**$ 11,877,961**	**$ 12,292,823**	**$ 12,722,329**	**$ 13,166,998**	**$ 13,627,362**	**$ 14,103,978**	**$ 14,597,418**	**$ 15,108,277**	**$ 15,637,169**	**$ 16,184,731**
Expenditures																	
Budget Inflation Rate	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%	5.00%
Personnel Services	$ 1,864,414	$ 1,957,635	$ 2,055,516	$ 2,158,292	$ 2,266,207	$ 2,379,517	$ 2,498,493	$ 2,623,418	$ 2,754,589	$ 2,892,318	$ 3,036,934	$ 3,188,781	$ 3,348,220	$ 3,515,631	$ 3,691,412	$ 3,875,983	$ 4,069,782
Services & Commodities	$ 3,662,697	$ 3,845,832	$ 4,038,124	$ 4,240,030	$ 4,452,031	$ 4,674,633	$ 4,908,365	$ 5,153,783	$ 5,411,472	$ 5,682,046	$ 5,966,148	$ 6,264,455	$ 6,577,678	$ 6,906,562	$ 7,251,890	$ 7,614,485	$ 7,995,209
Capital	$ 50,000	$ 50,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 75,000
Transfers																	
Equipment Revolving	$ 100,000	$ 100,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000	$ 150,000
Computer Revolving	$ 1,950	$ 1,950	$ 1,950	$ 1,950	$ 1,950	$ 2,100	$ 2,100	$ 2,100	$ 2,100	$ 2,100	$ 2,250	$ 2,250	$ 2,250	$ 2,250	$ 2,250	$ 2,250	$ 2,250
Capital Reserve	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000	$ 250,000
Revenue Debt	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
GO Debt	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Billing & Accounting	$ 648,515	$ 680,941	$ 714,988	$ 750,738	$ 788,275	$ 827,688	$ 869,073	$ 912,526	$ 958,153	$ 1,006,060	$ 1,056,363	$ 1,109,181	$ 1,164,640	$ 1,222,873	$ 1,284,016	$ 1,348,217	$ 1,415,628
Upcoming Projects																	
Repaint Water Tower #2 & Water Maintenance Facility Expansion [$3.5 million GO]																	
Water Facilities Expansion, Phase 1A & 2 (partial) [$12.4 million SRF]	$ 844,973	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800	$ 844,800
Water Facilities Expansion, Phase 2 (partial) [$8.4 million SRF]	$ 572,090	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292	$ 572,292
Water Facilities Expansion, Phase 3 [$14.2 million SRF]	$ 967,034	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523	$ 966,523
Total Expenditures	**$ 8,961,674**	**$ 9,269,973**	**$ 9,669,193**	**$ 10,009,624**	**$ 10,367,077**	**$ 10,742,553**	**$ 11,136,645**	**$ 11,550,441**	**$ 11,984,928**	**$ 12,441,138**	**$ 12,920,310**	**$ 13,423,282**	**$ 13,951,403**	**$ 14,505,930**	**$ 15,088,183**	**$ 15,699,549**	**$ 16,341,483**
Net Change in Fund Balance	**$ 664,505**	**$ 498,717**	**$ 244,145**	**$ 50,531**	**$ 144,608**	**$ 241,185**	**$ 340,600**	**$ 327,520**	**$ 307,895**	**$ 281,191**	**$ 246,688**	**$ 204,081**	**$ 152,575**	**$ 91,489**	**$ 20,094**	**$ (62,380)**	**$ (156,752)**
Beginning Fund Balance	$ 6,227,822	$ 6,892,328	$ 7,391,045	$ 7,635,190	$ 7,685,721	$ 7,830,329	$ 8,071,514	$ 8,412,113	$ 8,739,633	$ 9,047,528	$ 9,328,719	$ 9,575,407	$ 9,779,488	$ 9,932,063	$ 10,023,552	$ 10,043,646	$ 9,981,266
Ending Fund Balance	**$ 6,892,328**	**$ 7,391,045**	**$ 7,635,190**	**$ 7,685,721**	**$ 7,830,329**	**$ 8,071,514**	**$ 8,412,113**	**$ 8,739,633**	**$ 9,047,528**	**$ 9,328,719**	**$ 9,575,407**	**$ 9,779,488**	**$ 9,932,063**	**$ 10,023,552**	**$ 10,043,646**	**$ 9,981,266**	**$ 9,824,514**
% Reserved	76.91%	79.73%	78.96%	76.78%	75.53%	75.14%	75.54%	75.66%	75.49%	74.98%	74.11%	72.85%	71.19%	69.10%	66.57%	63.58%	60.12%
Personnel Cost in $	$ 2,512,929	$ 2,638,576	$ 2,770,505	$ 2,909,030	$ 3,054,481	$ 3,207,205	$ 3,367,566	$ 3,535,944	$ 3,712,741	$ 3,898,378	$ 4,093,297	$ 4,297,962	$ 4,512,860	$ 4,738,503	$ 4,975,428	$ 5,224,200	$ 5,485,410
Personnel % of Water	28.04%	28.46%	28.65%	29.06%	29.46%	29.86%	30.24%	30.61%	30.98%	31.33%	31.68%	32.02%	32.35%	32.67%	32.98%	33.28%	33.57%
Debt Service Coverage																	
Net Revenue/All Revenue Debt	1.45	1.38	1.30	1.22	1.26	1.30	1.34	1.34	1.33	1.32	1.30	1.29	1.26	1.24	1.21	1.17	1.13
Required Coverage	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10	1.10
Difference (Actual vs. Required)	**0.35**	**0.28**	**0.20**	**0.12**	**0.16**	**0.20**	**0.24**	**0.24**	**0.23**	**0.22**	**0.20**	**0.19**	**0.16**	**0.14**	**0.11**	**0.07**	**0.03**

2025 Water Facility Plan

Financial Forecasting Model

WATER CAPITAL FUNDS	FY24 Actual	FY25 Budget	FY26 Budget	FY27 Estimated	FY28 Estimated	FY29 Estimated	FY30 Estimated	FY31 Estimated	FY32 Estimated	FY33 Estimated	FY34 Estimated	FY35 Estimated	FY36 Estimated	FY37 Estimated	FY38 Estimated	FY39 Estimated	FY40 Estimated
Water Capital Reserve Fund Summary (602)																	
Beginning Balance	$ 555,881	$ 720,071	$ 800,071	$ 880,071	$ 960,071	$ 1,040,071	$ 1,120,071	$ 1,270,071	$ 1,420,071	$ 1,570,071	$ 1,720,071	$ 1,920,071	$ 2,120,071	$ 2,320,071	$ 2,520,071	$ 2,720,071	$ 2,920,071
Developer Fees	*$ 16,503*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*
Transfer from Water Utility Fund	*$ 215,000*	*$ 110,000*	*$ 305,000*	*$ 410,000*	*$ 305,000*	*$ 256,000*	*$ 340,000*	*$ 250,000*	*$ 250,000*	*$ 250,000*	*$ 300,000*	*$ 300,000*	*$ 300,000*	*$ 300,000*	*$ 300,000*	*$ 300,000*	*$ 300,000*
Projects Funded/Projected																	
Fleet/Attachments	*$ 59,756*	*$ 30,000*		*$ 210,000*	*$ 125,000*	*$ 160,000*	*$ 190,000*										
Equipment	*$ 7,557*		*$ 50,000*			*$ 16,000*											
Facilities/System (wells, plant, hydrants)			*$ 175,000*	*$ 120,000*	*$ 100,000*												
Membrane Replacement																	
TBD								*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*
Ending Balance	**$ 720,071**	**$ 800,071**	**$ 880,071**	**$ 960,071**	**$ 1,040,071**	**$ 1,120,071**	**$ 1,270,071**	**$ 1,420,071**	**$ 1,570,071**	**$ 1,720,071**	**$ 1,920,071**	**$ 2,120,071**	**$ 2,320,071**	**$ 2,520,071**	**$ 2,720,071**	**$ 2,920,071**	**$ 3,120,071**
Water Capital Projects Fund Summary (605)																	
Beginning Balance	$ 87,841	$ 87,841	$ 87,841	$ 87,841	$ 162,841	$ 237,841	$ 287,841	$ 337,841	$ 387,841	$ 437,841	$ 487,841	$ 537,841	$ 587,841	$ 637,841	$ 687,841	$ 737,841	$ 787,841
Transfer from Water Utility Fund	*$ -*	*$ -*	*$ -*	*$ 75,000*	*$ 75,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*	*$ 50,000*
Projects Funded/Projected																	
TBD																	
Ending Balance	**$ 87,841**	**$ 87,841**	**$ 87,841**	**$ 162,841**	**$ 237,841**	**$ 287,841**	**$ 337,841**	**$ 387,841**	**$ 437,841**	**$ 487,841**	**$ 537,841**	**$ 587,841**	**$ 637,841**	**$ 687,841**	**$ 737,841**	**$ 787,841**	**$ 837,841**
Total Capital Reserve Fund Balance	**$ 807,912**	**$ 887,912**	**$ 967,912**	**$ 1,122,912**	**$ 1,277,912**	**$ 1,407,912**	**$ 1,607,912**	**$ 1,807,912**	**$ 2,007,912**	**$ 2,207,912**	**$ 2,457,912**	**$ 2,707,912**	**$ 2,957,912**	**$ 3,207,912**	**$ 3,457,912**	**$ 3,707,912**	**$ 3,957,912**
Assigned Balance (savings for future expenditures, FY balance as listed)																	
Membrane Replacement	$ 240,000	$ 320,000	$ 400,000	$ 480,000	$ 560,000	$ 640,000	$ 740,000	$ 840,000	$ 940,000	$ 1,040,000	$ 1,140,000	$ 1,240,000	$ 1,340,000	$ 1,440,000	$ 1,540,000	$ 1,640,000	$ 1,740,000
Total Unassigned Balance	$ 567,912	$ 567,912	$ 567,912	$ 642,912	$ 717,912	$ 767,912	$ 867,912	$ 967,912	$ 1,067,912	$ 1,167,912	$ 1,317,912	$ 1,467,912	$ 1,617,912	$ 1,767,912	$ 1,917,912	$ 2,067,912	$ 2,217,912

2025 Water Facility Plan

Financial Forecasting Model

WATER CAPITAL FUNDS	FY41 Estimated	FY42 Estimated	FY43 Estimated	FY44 Estimated	FY45 Estimated	FY46 Estimated	FY47 Estimated	FY48 Estimated	FY49 Estimated	FY50 Estimated	FY51 Estimated	FY52 Estimated	FY53 Estimated	FY54 Estimated	FY55 Estimated	FY56 Estimated	FY57 Estimated
Water Capital Reserve Fund Summary (602)																	
Beginning Balance	$ 3,120,071	$ 3,370,071	$ 3,620,071	$ 3,920,071	$ 4,220,071	$ 4,520,071	$ 4,820,071	$ 5,120,071	$ 5,420,071	$ 5,720,071	$ 6,020,071	$ 6,320,071	$ 6,620,071	$ 6,920,071	$ 7,220,071	$ 7,520,071	$ 7,820,071
Developer Fees	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*	*$ -*
Transfer from Water Utility Fund	*$ 350,000*	*$ 350,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*	*$ 400,000*
Projects Funded/Projected																	
Fleet/Attachments																	
Equipment																	
Facilities/System (wells, plant, hydrants)																	
Membrane Replacement																	
TBD	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*	*$ 100,000*
Ending Balance	**$ 3,370,071**	**$ 3,620,071**	**$ 3,920,071**	**$ 4,220,071**	**$ 4,520,071**	**$ 4,820,071**	**$ 5,120,071**	**$ 5,420,071**	**$ 5,720,071**	**$ 6,020,071**	**$ 6,320,071**	**$ 6,620,071**	**$ 6,920,071**	**$ 7,220,071**	**$ 7,520,071**	**$ 7,820,071**	**$ 8,120,071**
Water Capital Projects Fund Summary (605)																	
Beginning Balance	$ 837,841	$ 887,841	$ 937,841	$ 1,012,841	$ 1,087,841	$ 1,162,841	$ 1,237,841	$ 1,312,841	$ 1,387,841	$ 1,462,841	$ 1,537,841	$ 1,612,841	$ 1,687,841	$ 1,762,841	$ 1,837,841	$ 1,912,841	$ 1,987,841
Transfer from Water Utility Fund	*$ 50,000*	*$ 50,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*	*$ 75,000*
Projects Funded/Projected																	
TBD																	
Ending Balance	**$ 887,841**	**$ 937,841**	**$ 1,012,841**	**$ 1,087,841**	**$ 1,162,841**	**$ 1,237,841**	**$ 1,312,841**	**$ 1,387,841**	**$ 1,462,841**	**$ 1,537,841**	**$ 1,612,841**	**$ 1,687,841**	**$ 1,762,841**	**$ 1,837,841**	**$ 1,912,841**	**$ 1,987,841**	**$ 2,062,841**
Total Capital Reserve Fund Balance	**$ 4,257,912**	**$ 4,557,912**	**$ 4,932,912**	**$ 5,307,912**	**$ 5,682,912**	**$ 6,057,912**	**$ 6,432,912**	**$ 6,807,912**	**$ 7,182,912**	**$ 7,557,912**	**$ 7,932,912**	**$ 8,307,912**	**$ 8,682,912**	**$ 9,057,912**	**$ 9,432,912**	**$ 9,807,912**	**$ 10,182,912**
Assigned Balance (savings for future expenditures, FY balance as listed)																	
Membrane Replacement	$ 1,840,000	$ 1,940,000	$ 2,040,000	$ 2,140,000	$ 2,240,000	$ 2,340,000	$ 2,440,000	$ 2,540,000	$ 2,640,000	$ 2,740,000	$ 2,840,000	$ 2,940,000	$ 3,040,000	$ 3,140,000	$ 3,240,000	$ 3,340,000	$ 3,440,000
Total Unassigned Balance	$ 2,417,912	$ 2,617,912	$ 2,892,912	$ 3,167,912	$ 3,442,912	$ 3,717,912	$ 3,992,912	$ 4,267,912	$ 4,542,912	$ 4,817,912	$ 5,092,912	$ 5,367,912	$ 5,642,912	$ 5,917,912	$ 6,192,912	$ 6,467,912	$ 6,742,912

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